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THE KALEVALA.

BY EDWARD CLODD.

IV.

THE third rune narrates how Wäinämöinen dwelt at his ease in Wainola, singing unwearingly the songs which tell of noble deeds and of the wondrous story of the beginnings; singing with such power and sweetness that his renown reached the ears and stirred the envy of Joukahainen, a younger bard in Pohjola.

The harp and song of Wäinämöinen play so important a part in an epic in which the triumph of words over brute force is manifest throughout, that he is to the Finns as Jubal to the Hebrews, "the father of all such as handle the harp and organ." But some of the old lyrics speak of one Kaleva, long since dead (corresponding to Kalew of the Kalevipöeg), whom, in an episode to be told in its place, Wäinämöinen roused from his earth-forgetting sleep, enforcing from him the gift of song which caused sun, moon, and waterfall to pause and listen. There is much diverse opinion as to whether Kaleva is a person or an epithet, and the evidence adduced by Castrén inclines the balance in favour of the latter; but this is a detail of exposition into which we must not be beguiled here.

Joukahainen, young and boastful, vowed, despite the warnings of his parents, to visit Kalevala and challenge Wäinämöinen to trial of song:

> Singing, I shall so transform him
> That his feet shall turn to flintstone,
> And to oak his nether garments;
> And bewitched the bard shall carry
> On his breast a stony burden,
> On his shoulder bow of flintstone,
> On his right hand stony gauntlet,
> On his skull a stony visor.

Having harnessed his fiery steed to a golden sledge, he galloped southwards, and met Wäinämöinen driving quietly across the meadows of Wainola. Joukahainen then drove full tilt into his rival's sledge, whereupon the "old and steadfast" asked:—

> Let me know, thou stupid fellow,
> Who thou art, and whence thou comest?

Joukahainen made rough answer, bragging of his skill in song, whereupon Wäinämöinen bade him give proof of that. Joukahainen then sang commonplaces in commonplace words, and Wäinämöinen told him to cease his foolish prattle of "old wives' tales and wit of children," and to sing themes worthy of a bearded hero, about the world's beginning and eternal things. Joukahainen then changed his key, and made lying boast, in words akin to those of Wisdom in the Book of Proverbs, that when the earth was created, he was there to fix the everlasting pillars, and strew the stars in the firmament. Angry with the "shameless braggart," Wäinämöinen so enraged him that he would fain cross swords, but the old bard refused the challenge, and then, filled with a divine wrath at the taunt of cowardice, poured forth his mighty songs. As he sang of the creation, the building of the air, the raising of the arch of heaven, the sea heaved, the "copper-bearing mountains" were shaken, and alas! for Joukahainen, his sledge was transformed into saplings, his steed into stone, his sword leaped into the sky as a gleam of lightning, and he himself, "sorry fellow," sank deeper and deeper in the swamp, till he was choked with moss and water. Nor was he released save by the same enchantment which had engulfed him, and then only when, after vainly tendering many bribes, he promised to give his fair sister Aino to Wäinämöinen.

> Aino, daughter of my mother!
> Aino, my beloved sister!
> Bride of thine to be for ever.
> Every morn to sweep thy cabin;
> Bake the toothsome honey-biscuit;
> Deck thy bed with snowy linen;
> Weave thy couch and golden cover;
> All the place to hold in order.

Joukahainen returned to his mother in sorry plight, and told her what had befallen him, and how he had promised his beautiful sister to the aged bard. While his mother sought to comfort him Aino entered, and when she heard the tidings sadness came upon her, which those around her sought in vain to remove. She shrank from Wäinämöinen, and, tearing off her jewels, vowed never to wear them again or to become his bride. Her mother, to divert her mind, bade her go in search of lovelier jewels than those which she had cast away, and these Aino found, and decked herself therewith. But not for her marriage, as her mother hoped, for, instead of returning home, she wandered far away, singing songs of yearning for the dwelling of Tuoni, the god of death.

> Yea, the time has come for Aino,
> From beneath the sky to hasten
> To the realms of the departed,
> Underneath to Mana's kingdom.

She reached the "curving sea-shore," and after a night of weariness and weeping, unrobed herself, and swimming to a many-coloured stone which swayed bottomwards, was carried with it to the rocky ocean-bed, chanting farewells as she sank. The sequel suggests the classic strains of Cock Robin:—

> Who shall bear the cruel tidings?
> Who shall tell the cruel story?
> At the pretty maiden's cottage,
> At the home of lovely Aino?

Not the bear, for he will forget his mission, and "tear the peaceful cattle;" not the wolf, he would "frighten sheep and shepherd;" not the fox, he the "geese would slaughter;" but the hare, timid and swift, he shall tell the mournful story.

Then the bereaved mother bemoaned her folly in urging the union with Wäinämöinen, and the bitter tears that she shed fell so thick and fast that they formed foaming cataracts.

XUM

Meanwhile Wäinämöinen, weeping day and night for his vanished love, made vain search for her, till, on a clue given him, he went fishing, and hooked a salmon so fair that he had never seen its equal. But as he made ready to rip it open it sprang back into the water, and revealed itself to him as the metamorphosed Aino; nor could fresh cast of net or words of his, "charm he never so wisely," recover the lost and mourned-for prize. Then from the ocean depths his now aged mother rose, and, telling him that there are as good fish in the sea as ever yet were caught (or lost), counselled him to seek a wife in Pohjola.

Joukahainen's hatred towards Wäinämöinen for vanquishing and humiliating him had not abated, and he set out to entrap him on his way thither. As Wäinämöinen rode across the sea Joukahainen shot at and missed him, but the poisoned arrow struck his horse, whereby Wäinämöinen was thrown into the water, but saved from sinking by a storm, which carried him to and fro on the surface of the waves. Borne upon their crests for many days, he was at last rescued by the eagle which he had befriended when he left the birch-tree standing; and, carried on the grateful bird's back, he was, after escaping further perils, landed on the Northland shore. There, sorely bruised, with a thousand buffets on his body, with locks wildly tossing in the wind, with wild sobs, and bewildered which way to take, the "old and steadfast" was at last found by Louhi the Toothless, mistress of Pohjola, mother of Louhetar, its fairest maiden. She took him into her house, and gave him food and shelter; but, wearied of eating the bread of strangers, he sighed for the meadows of Wainola, and would fain depart, only Louhi would not let him, neither would she give him Louhetar in marriage until he forged the Sampo.

This mysterious thing, which is introduced in the seventh rune and disappears only in the forty-third, rules the fortunes of its possessors, and its identification is as great a *crux* to commentators on the Kalevala as that of the little Horn in Daniel and the number of the Beast in the Apocalypse is to commentators on those books. It has been variously interpreted as an image of Jumala, as a Jumala temple, the culture and progress of the human race, as a Laplander's magic-drum, as a merchant vessel, a well, the earth, a cloud, the rainbow, and, of course, as both the dawn and the sun. Of this last theory O. Donner and A. Schiefner are the most authoritative defenders, and there are descriptions in the Kalevala which support it—*e.g.*,

> It is well to dwell in Pohja,
> For in Pohja there is Sampo,
> There is ploughing, there is sowing,
> There is every plant and seed-grain,
> There is everlasting gladness.

But when, as will be seen, the Sampo is carried off:

> There is sorrow now in Pohja,
> And a breadless life in Lapland.

And of the fragments, which, when the Sampo is broken, are washed to the shores of Kalevala, it is said—

> They bear every seed within them
> And eternal joys beginning;
> They will make the moon to brighten,
> Sun of joy to shine for ever.

The Sampo grinds corn, salt, and treasure, like the famous quern of Norse myth in the well-known story "Why the Sea is Salt;" and Castrén, in his "Finnish Mythology," refers to the relationship between the Swedish *stamp*—a handmill—and its Finnish form *tamppu*. In that language a word cannot begin with two consonants; and, therefore, in adopting *stamp*, the *t* is rejected.* This luck-bringing Sampo was many-coloured, with ornamental lid or cover, and was made of the following unique fetichistic materials—a swan's feather, a grain of corn, a bit of wool, two lamb bones, a drop of milk, and piece of a spindle. It is also described as having three roots, in which some correspondence between it and the tree Iggdrasil of Norse myth, with its three roots, are perhaps traceable.* At any rate, such foreign elements as may have been imported into the Kalevala are to be looked for in that direction, although Herr Olcenius, in an elaborate essay on the subject, has brought together a number of ingenious similarities in detail between the voyage of the Finnish heroes to capture the Sampo, and the voyage of the Argonauts to recover the Golden Fleece. The independent invention of stories of like adventures to secure coveted treasure from hostile possessors is a more probable explanation of the correspondences than the assumption of migration of Greek myth to Finland.

Wäinämöinen, although described in some variants of the Kalevala as a smith, was no skilled artificer, and, since he could not make the Sampo, he undertook to send his brother Ilmarinen, the Vulcan of the epic, the mighty metal-worker, who, like Ilmarine in the Kalevipöeg, fashioned the steel vault of heaven. The references to metal-work is one of many proofs of relatively modern elements in the Kalevala.

On this promise Louhi gave him a horse and sledge to take him home, and as he journeyed he saw the lovely Northland daughter sitting on a rainbow and weaving golden threads, for to such, or to webs, were the slanting sun-rays likened in primitive myth. She, the red-stockinged (the colour of the stockings worn by the women in the epic is an amusingly recurring detail) accepted his offer of a seat in his sledge if he would, after the manner familiar to wooers of maidens in folk-tales, do certain wonderful tasks. He must split a horsehair with a knife which has no edge; he must cut an egg in two without leaving a mark; he must build a boat of the shivers of her spindle, and get it to the water without moving it. He performed the first two feats, but in the third wounded himself in the knee with his axe, and could not be healed through forgetting the only words of the spell which could cure him. To find these, he limped to an old sorcerer and sang to him a quaint legend, which has no apparent connection with the thread of events, of the birth of iron and steel from maiden's milk.

> Faltering they began their journey,
> From the cloud-rim stepping downward,
> And their bounteous breasts were swollen,
> So that all their nipples pained them.
> Then, on earth their milk down-pouring,
> Flowed the fulness of their bosoms,
> Through the earth and through the marshes,
> Aye, and through the drowsy billows.
> Black the milk that one produceth—
> She, the eldest of the virgins;
> White the milk the second spilleth—
> She that was the next begotten;
> Red the milk the last outpoureth—
> She, the youngest of the maidens.
> Whereso'er the black milk trickled,
> There soft iron sprang to being;
> Where the white milk came down-pouring,
> There was hardened steel created;
> Where the red milk ran in rivers,
> There did brittle iron follow.

The sorcerer then cursed the iron as a living thing for its evil nature, and prayed to Ukko, "in whose hands is

* The name *Sampo* does not occur either in the Esthonian or Lapland myth.

* "One of them extends to the Æsir, another to the Frost-giants in that very place where was formerly Ginnung gap, and the third stands over Niflheim, and under this root, which is constantly gnawed by Nidhögr, is Hvergelmir." Mallet's "Northern Antiquities," Prose Edda, p. 411.

the end of a matter," to heal the wound. The blood was staunched by a charm; the prayer was answered, and the "old and steadfast" wooer made well again. On reaching Wainola, he told Ilmarinen all that had happened, and asked him to aid his suit by *forging* (so says a later version) the Sampo, or, according to another account, told him he could have the red-stockinged girl himself for his pains. But Ilmarinen was a misogamist, and declared that, even if he wanted a wife, he would not go to the dreary Northland for one. The artful Wäinämöinen then caused a fir-tree to rise heaven-high from the earth, and encouraged Ilmarinen's desire to climb it that he might touch the moon. Having thus got his brother "up a tree," Wäinämöinen raised a hurricane which uprooted the tree and carried it with Ilmarinen to Pohjola. There, after repeated failures, he succeeded in making the Sampo, which Louhi then hid in a copper mountain behind nine locks and bolts. But the daughter would not wed him, pleading that she could not leave Pohjola, whereupon Ilmarinen returned to Kalevala.

OUR HOUSEHOLD INSECTS.

By E. A. Butler.

THE study of insect life is so essentially a matter of out-door work, that those to whom few opportunities of country rambles occur, and whose sole change of air and scene is from the home to the office, workshop, or factory, are tempted to throw the matter over without consideration as hopeless. And yet this need not altogether be the case, for, as we hope to show in the present series of papers, there is considerable scope for entomological researches even within the four walls of a house. Man is accompanied in his migrations, not merely by what are familiarly known as the "domestic animals," but also by hosts of insects, which find improved means of subsistence by linking their fortunes with his, and which, though often causing him infinite annoyance, sometimes render considerable, though generally unrecognised and unappreciated, services. In their persistent accompaniment of their lord and master, some have travelled over vast areas of land and sea, getting free passages in all the navies of the world, and we in this country owe several of our commonest insects to our commerce with foreign nations. It is "cupboard love" that impels insects to accompany man; they follow him for what they can get; his food they pilfer; his heirlooms they destroy; his house, his furniture, his clothes, they attack; and even his very person is not held sacred, especially if he himself so sins against nature as to violate the laws of cleanliness and health. So, not an abode can be found—whether of the most degraded barbarian on the one hand, or of the very cream of civilised society on the other—which can boast of immunity from the intrusion of representatives of this immense horde of living creatures, a class whose species far outnumber those of all other sections of the animal kingdom, having been estimated even at over 150,000. That some of this vast host should have special relations to mankind is not to be wondered at, when we remember that two of the chief functions of insect life in the world seem to be the repression of superabundant vegetation, and the removal of effete and waste matters; for while man in his agricultural capacity bids mother earth bring forth the "herb yielding seed after his kind," more and more abundantly, he often finds a serious check to his efforts in the mighty hosts of insects which the very success of his agricultural operations has been the means of vastly increasing; and, again, while in his constructive and manufacturing capacity he is busily engaged in converting natural products of the animal and vegetable worlds into things suitable for his own use, he thereby attracts the scavenger hosts, who, evidently regarding his accumulations of manufactured articles as so much lumber to be got rid of as quickly as may be, set to work on his cherished hoards with right good will, and tax all his ingenuity to save them from ruin. So it comes to pass that there are many species of insects that more or less permanently take up their abode with us, either actually in our houses and outbuildings, or in our cultivated lands, and depend in large degree upon us and our belongings for their support. It is only with the former of these groups that we propose at present to deal, but we shall find in them good representatives of insect life in general; in fact, there is not a single important order unrepresented in domestic entomology. Beginning with the highest, we turn our attention first to the

COLEOPTERA, OR BEETLES.

Of these, a considerable variety make our houses their foraging quarters, and one of the most important sections is that of the "wood-borers." These often commit great depredations in the beams and other woodwork used in the framework of houses, as well as in articles of furniture, producing the result known as "worm-eaten." Formerly, their ravages were more considerable than at the present day, owing to the then more extensive use of timber (and especially unpainted timber) in building construction. The external indications of the presence of these destructive insects are usually two-fold; small circular perforations in the surface of the wood, and little heaps of yellow dust on the ground beneath them. The perforations are the entrances to, or rather exits from, long cylindrical tunnels traversing the wood in various directions (generally in that of its length), and often to so great an extent as to leave only the narrowest of partitions between them, and so reduce the whole interior to a mere network, which is so fragile as to crumble away on the slightest touch, while the outside still remains intact except for the few perforations, and gives the wood the appearance of being almost as sound as when first put up. The beetles themselves are not so often seen, as they spend a large proportion of their life in their burrows. Their ravages are similar in result to those of the shipworm upon submerged timber, though the latter animal belongs to the Mollusca, and is a relative of such animals as the mussel, oyster, &c.

Fig. 1.—Anobium Domesticum.

Several species of beetles are answerable for these damages; the commonest is a small cylindrical insect called *Anobium domesticum* (Fig. 1). It is scarcely $\frac{1}{8}$th of an inch long, of a dark brown colour, and, like most of its allies, has the head much sunk in the thorax, which is raised behind into a protuberance in such a way as to cause it to resemble a hood or cowl; when viewed sideways this has a most quaint appearance, and irresistibly reminds one of a coal-scuttle bonnet, almost entirely enveloping the head. The elytra, or wing-covers, are marked with narrow parallel longitudinal furrows, and are covered with short, soft hairs, termed collectively "pubescence"; under them are folded a pair of large-sized wings. The legs are of moderate length, but can be closely packed away under the body, when the insect looks like a mere cylindrical pellet

of wood, earth, or other inorganic matter, or like a miniature cartridge fitting well into the tubular burrows; in this condition it may be rolled about without manifesting signs of life. The antennæ have the last three joints much larger and longer than the rest, a peculiarity which also pertains to other members of the family.

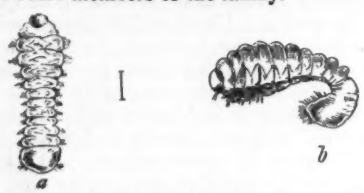

Fig. 2.—Larva of Anobium Domesticum (*a*, back view; *b*, side view).

In its larval condition this insect is a thick, fleshy grub (Fig. 2), somewhat curved, and swollen at each end. On the anterior part of the body it carries six tiny legs, a pair on each of the three segments immediately succeeding the head. It is of a whitish colour, as might be expected in a creature which spends its time in the darkness of a tunnel; only in the jaws and that part of the head immediately surrounding the mouth is any more definite colour to be found, and this part appears as a dark, brownish-black spot on the otherwise immaculate insect.

Except in the head, the skin is soft and yielding, and a few hairs are scattered along its sides. These larvæ are very seldom seen, as in order to get at them the wood in which they are domiciled must be pulled to pieces. Their food consists of the wood itself, which, by their powerful, though tiny jaws, is bitten off in minute particles, many of which, however, are left uneaten, and either clog up the burrows or are ejected at their openings, where they constitute the tiny heaps of yellow dust referred to above. No wood is so old and dry that they cannot extract nourishment from it; in fact, the older and drier it is the better they like it. An animal subsisting on such food might be expected to be a lean, wiry creature, of half-starved aspect, but exactly the contrary is really the case; for these white grubs are fat and flourishing, and a full-grown one might be supposed to have been fattening up for a prize competition, for it looks as bloated as a prize pig. They pupate in their burrows, enveloping themselves in a silken cocoon, in which are interwoven particles of the dust they make. On emerging from the chrysalis they remain inactive for some time, not coming out of their burrows, and only gradually acquiring their normal colour and consistency, and with these their activity.

(*To be continued.*)

RAIN.

By Richard A. Proctor.

(*Continued from page* 215.)

DESPITE the evidence set forth in the previous article, Sir John Herschel holds a contrary opinion. He points out that the observations of De Saussure and Kratzenstein may be readily referred to the effect of optical illusion. The strongest argument put forward by Kratzenstein is founded on the fact that rainbows are never formed on clouds or fogs, as they would be (according to the undulatory theory of light) if these meteors were composed of globules of water. Sir John Herschel, a higher authority on optical questions than either De Saussure or Kratzenstein, is of opinion, on the contrary, that it is possible a re-examination of the very difficult point in question would give a different account than that usually accepted.

Herschel points out the difficulty of understanding in what manner the condensation of true vapour should result in the formation of a hollow vesicle. Tyndall points out, on the other hand, a difficulty depending on the state into which water particles at high elevations sometimes pass. "It is certain," he says, "that they possess, on or after precipitation, the power of building themselves into crystalline forms; they thus bring forces into play which we have hitherto been accustomed to regard as molecular, and which could not be ascribed to the aggregates necessary to form vesicles."

In whatever state the particles of a cloud really exist, it is certain that the fall of rain depends on a process of increased condensation. The causes producing such condensation have been thus summed up by Professor Nichol:—

(1) The cooling of clouds through the effect of radiation from them;

(2) The mingling of vapours at different temperatures—a mingling effected by the agency of the winds;

(3) The rising of vapours towards colder strata of the atmosphere;

(4) The increase of atmospheric density or pressure;

And (5) The accumulation and impinging of masses of vapour against some obstacle.

Singularly enough he omits the most important of all known agencies in the production of rain, viz.:—

(6) The transfer from the equator towards the poles of large masses of moisture-laden air by means of the upper S.W., or counter trade-winds.

I must note also that cause (4) is more than doubtful. Tyndall has shown that rarefaction is an efficient agent in producing the precipitation of vapour. By increase of pressure a larger quantity of moisture is, indeed, compressed within any given space; but, on the other hand, there is an increase of heat within the space which more than counterbalances the former in effect. "The heat developed," says Tyndall, speaking of an experiment illustrating the effects of increased pressure, "is more than sufficient to preserve it" (the moisture added to a given space) "in the state of vapour."

It will be seen at once from the above imperfect enumeration of causes affecting the production of rain, that the phenomenon is no simple one. When we add the variety of circumstances affecting the action of different causes—as the latitude of the place; the elevation above the sea-level; the proximity of the sea; the laws affecting the seasonal variations at the place; the prevailing winds; the configuration of the surrounding surface, it will become evident that meteorologists may well be perplexed by the very complex set of agencies acting in the production of rain; and so fail—as they have hitherto done—in interpreting any save the most general laws influencing the phenomenon.

Some of these general laws I now proceed to consider.

In the first place, it may be accepted as generally true that the amount of moisture present in the atmosphere is greatest near the equator, and diminishes towards the poles. With the sun's change of declination the zone of greatest moisture passes to the north or to the south of the equator, *following* the sun. The mean region, it is to be noted, is not absolutely coincident with the equator, but some four or five degrees north of that circle. It is easily intelligible that the hottest regions should be, *cæteris paribus*, those over which the amount of moisture present in the atmosphere is greatest, since the heat vaporises the water over these regions. It may not seem, at first sight, quite so obvious

that the same regions of greatest heat should also be those in which the rainfall should be in general heaviest. For it might appear that the same heat which produced the evaporation would maintain the water in a state of vapour. The fact, however, that aqueous vapour is lighter than air, operates to produce ascending currents over the region of evaporation, currents strengthened by the expansive effects of the heat. Accordingly, the vapour rises rapidly, and when it has thus risen, many circumstances operate to produce precipitation. First the upper regions are rarer; secondly, they are colder; thirdly, radiation of heat takes place rapidly from the upper surface of clouds, brought here, as Tyndall expresses it, into the presence of pure space (*dry air* having scarcely any appreciable effect in checking radiation). The result is that the uplifting of clouds under the sun's influence is followed regularly over the equatorial regions by the precipitation of heavy rain-showers. And *cæteris paribus*, the fall of rain decreases with distance from the equator of heat, though not so regularly as the amount of moisture decreases.

The next great law which presents itself to our consideration is this, that winds blowing towards the equator are, in general, dry winds, and winds blowing from the equator, rainy. This law is the direct consequence of the former, but it is necessary, for several reasons, to present it as a separate law. There is an erroneous method of accounting for this law which is very commonly met with in works on meteorology. It is argued, that as winds blowing towards the equator are carrying masses of air from colder to warmer regions, they are necessarily dry winds, since, if the air is saturated, or nearly so, at starting, it cannot be saturated when it has become warmer. And *vice versâ*, winds blowing towards the poles are carrying masses of air to colder regions. The air accordingly grows colder, and if not far from being saturated at starting, cannot fail to become unable to keep its whole burden of moisture in the state of vapour, and must accordingly precipitate a portion as rain. This explanation is insufficient. It would, indeed, be just as reasonable to reverse the argument thus: a wind blowing towards the equator must bring rain; for, as it brings cold air into warm regions, if the air in these regions is nearly saturated, the introduction of cold air must lead to the precipitation of a part of the moisture, and *vice versâ*, a wind blowing towards the poles must be a dry, because it is a heat-bearing, wind. The simple explanation of the law is, that winds blowing towards the equator are dry, because they are blowing from regions over which moisture is less, to regions over which moisture is more abundant, and *vice versâ*. Of course we must superadd to this the facts mentioned above, because a moist wind blowing towards a heated region would not bring rain with it, and a comparatively dry wind, blowing towards a cold region might bring rain. But it must not be forgotten that the main question to be considered is the relative moistness of the transported masses of air.

We meet with corresponding laws affecting the rain-producing powers of winds travelling over continents and oceans. A wind blowing over an ocean towards a continent brings rain to the continent, unless the heat over the latter exceeds slightly, or at the least, does not fall short of, the heat over the neighbouring ocean. Such a wind is certain to bring rain to an elevated continental region not protected by a mountain barrier yet more elevated. On the other hand, a wind blowing over a continent towards the ocean in general brings no rain.

Lakes, marshes, and rivers act in a small way a similar part towards the adjoining lands as oceans towards neighbouring continents.

There are circumstances also to be considered as affecting the rainfall in a different manner, viz., not by supplying a greater or less amount of moisture to the atmosphere, but by affecting the power of the atmosphere to keep the moisture it supports in the vaporous state. Such are the *contour* and *elevation* of a country, the nature of its soil, the quantity of forest land, or, wanting this, the relative abundance or paucity of trees, and so on.

A moist and warm current of air impinging on a mountain range, or even on any well-defined rising slope, so as to be carried with sufficient suddenness to colder and rarer regions, is compelled to part with a large portion of its moisture in the form of rain; and conversely a wind which has passed over a mountain range or an elevated plateau, and descends to a lower region, appears as a dry wind, unless that region is one over which a continual process of evaporation sufficient to maintain the air nearly in a state of saturation is going on. In this latter case the effects of the descending wind will vary with circumstances. It will in general appear as a dry wind, but may produce local showers, since it may act, through the sudden addition of cold air, the part of a condenser.

Forests are great generators of rain. This is mainly due to the peculiar radiative power of trees and vegetables. The soil, where it is covered with vegetation, receives no heat directly from the sun, and but little through contact with the heated air. It may seem like a confusion of cause and effect to speak of vegetation-covered countries as rain-generators, since abundant rain is so important a requisite for the abundant growth of vegetables. This is, however, a case in which cause and effect are interchangeable. Rain encourages vegetation, and vegetation in turn aids in producing a state of the superincumbent atmosphere which encourages the precipitation of rain. The result is that, apart from external agencies, regions covered with abundant vegetation, and especially with high trees, present year after year, and century after century, a ranker yet ranker luxuriance of vegetable growth.

On the contrary, arid regions prevent, by their very aridity, and consequently by the intense heat of the soil and superincumbent air, the downfall of the showers which would nourish vegetation. The result is, that even when the soil itself is favourable, it is exceedingly difficult to convert an arid into a vegetation-covered district, the want of moisture being destructive to trees planted in such soils with the object of encouraging rainfall. The process of change must be a gradual one. On the other hand, the improvement of a region over which rain falls too heavily through overabundant vegetation is a comparatively simple process, a judicious system of clearing invariably leading to the desired result.

(To be continued.)

THE BRIGHTON ELECTRIC RAILWAY.

By W. SLINGO.

THE astonishment which was experienced by those of us or our fathers who beheld the progress of a railway train in the early days of Stephenson's public career, was great indeed. It was certainly a fresh start in life's ways, and fairly deserved all the attention that was, and still is, being bestowed upon it. The steam locomotive has, however, become so immensely useful to us, that it may be fairly regarded as having earned for itself a place amongst the necessities of life. Nevertheless, strange and impressive as was the idea of a string of carriages being hurried along the iron road at the behest of the engine, still more

strange and impressive would it be were we to see the carriages going along without the engine, like so many inanimate boxes, suddenly and mysteriously endowed with life. And yet this is not altogether a wild dream, as will be conceded by any one who studies the circumstances pertaining to the Brighton Electric Railway. Recently I adverted to an electrically-propelled car, in which the source of motive power lay in a few secondary cells or accumulators stowed under the seats; but when one sees these accumulators, the air of mystery surrounding a moving but horse-less and engine-less car is to a great extent dispelled. One requires, however, a keener perception of the laws of nature, a freer power of imagination to conceive the possibility and practicability of a car or coach to travel along a pair of rails, and pick up its power as it goes along, and yet this is what is actually being done, not only at Brighton, but also at Portrush and a number of other places. The principles upon which an electric railway may be constructed and worked being satisfactorily, and, albeit, modestly, applied at Brighton, and the subject being fraught at the present moment with importance and interest greater than have ever attached to it hitherto, a brief description of that typical work may here be given.

It was on July, 1, 1883, that the first application was made to the Brighton Corporation for permission to construct and work upon a portion of the Brighton beach the first electric railway opened in Great Britain. The necessary sanction was granted on July 20, and, accordingly, Mr. Volk set to work. He threw the greatest possible enthusiasm into the task, and progressed so satisfactorily as to be able to open his short railway for public use on the autumn Bank Holiday (Aug. 2) of 1883. The line started opposite the well-known Aquarium, and ended at the Chain Pier, a distance of about a quarter of a mile, the gauge being 2 ft., and the flanged rails weighing 20 lb. to the mile. The rails were fastened by means of spikes to longitudinal sleepers 9 in. by 3 in., cross-pieces being employed at intervals of 4 ft. to keep the line in position. The sleepers were coated with Stockholm tar, as a preservative against moisture, the presence of which would have had the double disadvantage of rotting the wood and affording an easy channel for the escape of the electricity, which, as will presently be seen, is transmitted through the rails attached to the sleepers. Very little was done in the matter of a permanent way, the shingle being simply levelled up and the sleepers laid upon it.

A small ornamental wooden car was built for the line, and was fitted with seats on either side, as in an ordinary tramcar, accommodation being provided for about a dozen passengers. The weight of the car was 7 cwt.

Now for the motive power. An Otto gas-engine of two horse-power nominal, and giving about three horse-power on the brake, was fixed in a shed at one end of the line, and was used to drive a Siemens dynamo-electric machine of the size known as D_3. The dynamo yielded a current of 25 ampères, with an electro-motive force of 50 volts. An electric motor was built by Mr. Volk, weighing about 2¾ cwt., and fixed on the underside of the car, its terminals being indirectly connected, respectively, to a wheel on either side of the car. The terminals of the generating dynamo were connected to the rails, so that the electrical circuit was completed through the motor when the car stood on the rails. The current, passing through the motor, caused its armature to revolve at 700 revolutions per minute. The pulley of the armature, 5 in. in diameter, was connected, by means of a belt, with a pulley on a counter-shaft, 10 in. in diameter, and this again by another belt to another pulley, 12 in. in diameter, fixed on to one of the axles. The speed of the car upon an incline of 1 in 100 was about five miles an hour; while on the return journey it was twice as rapid. At night-time a twenty-candle power Swan incandescent lamp, fitted on the roof of the car, was supplied with current from the rails, and afforded ample light for the purpose. The electrical resistance of the rails was ·05 ohm, and of the motor about ·55 ohm.

The passage of the current, and consequently the progress of the car, was controlled by means of a switch fixed at each end of the car, under the command of the driver. The same switch acted as a commutator, that is to say, the driver was able, by its means, to control the direction taken by the current in traversing the coils of the motor armature. Manifestly, a reversal of the current in the armature produced a reversal in the direction of revolution made by the armature, implying in consequence a reversal in the direction pursued by the car along the rails.

One very remarkable fact is worthy of notice: it has surprised every one in the world of practical electricity, and that is, that although the line is on the beach, and no other insulation is afforded than that above indicated, the loss of current by leakage is extremely small—that is, in comparison with what might have been expected. It is asserted that even on a wet day this loss did not exceed 5 per cent., while on a dry day it was, of course, much less than this. One reason for this is, doubtless, to be found in the fact that tar affords but little hold for films of moisture (which rather collects as isolated drops of water), while, the beach being composed of coarse pebbles, there was little harborage for water, which ran away before it had time to accumulate.

On the opening day the car ran backwards and forwards for eleven hours without a hitch, making 100 journeys, and carrying a total of 1,200 passengers. The interest excited was, as might be imagined, very great, and frequently the car was called upon to carry sixteen instead of twelve passengers.

The railway thus constructed and equipped continued in use until Jan. 4, 1884, when the road was taken up preparatory to extending the line to Paston-place, and making alterations in the gradient so as to run under the Chain Pier.

Last Easter the reconstructed and re-equipped line, a mile in length, was opened for traffic, and continues without any material change. An elegant little "Station" was erected at the starting-point opposite the Aquarium. The longitudinal tarred sleepers were exchanged for transverse creosoted ones, 4 ft. 6 in. long, and laid three feet apart. The new gauge is 2 ft. 9 in. Where the line passes under the Chain Pier, a very severe dip has to be made, the incline being 1 in 16. Otherwise the road is tolerably level. The generating apparatus is provided with a comfortable and commodious home in a vault in the sea-wall opposite Paston-place. The engine—a Crossley 8-horse power gas-engine (consuming about 1,600 cubic feet of gas per day of eleven hours)—drives the generator, which is a Siemens D_2 dynamo electric machine. A Siemens dynamo is used as a motor, and is fixed to the under side of an admirably-upholstered car. The weight of the motor, switch, &c., is 7 cwt., which, considering the great power possessed, is very low, or at about the rate of one-twentieth of that which would be necessary were a steam motor used for the purpose. This is a feature of great importance, as the electric propulsion permits of a comparatively lightly-constructed permanent way. The new car is constructed to carry eighteen passengers inside and six on each footboard, or a total of thirty. Three twenty-candle-power Swan lamps are provided, one being suspended from the roof of the car, and one placed on the tailboard at each end. The generator is capable of pro-

ducing a current of 40 ampères, with an electro-motive force of 160 volts, while the motor absorbs 17 ampères, so that there is a considerable margin. It is estimated that in nine months the car has travelled some 25,000 miles. Although only constructed to carry 30 passengers, it has been known to carry 53, and on a single day 3,000 passengers have travelled the length of the line. So great is the popularity of the undertaking, that in ten months 300,000 passengers have been carried. The fact of such an extensive and continuous patronage is proof positive that the line is an actual success, for there can be no doubt that the novelty has long since worn off for the great majority of the travellers. Some of the townspeople have made, and continue to make, strenuous efforts to bring the experiment to a close, the objection raised being that the line is laid on the foreshore, which is public property. It is to be hoped, however, that such objections will be overruled. The line is in nobody's way, nor does it interfere with the public use of the beach to any appreciable extent —not nearly so much, in fact, as do the hosts of boats and bathing-machines which throng the beach. It is gratifying to notice that, from a monetary point of view, Mr. Volk is in every way pleased. He finds that the cost of haulage is but twopence per car-mile, while the average earnings are one shilling and fivepence—providing, therefore, an excellent margin for other expenses incident to the system.

As might be expected, Mr. Volk has not been free from trouble in connection with his railway. He experienced considerable difficulty in getting his plant together; carriage-builders were chary of building for a new venture, and wanted to be paid before commencing the work. Storms on one or two occasions washed away a part of the line. The last trouble of this kind took place about a week before Christmas, when a large portion of the line was washed away and the beach removed by the waves. A tall viaduct was built to level the line again, but, as soon as this was finished, back came the beach to even a greater extent than it had previously existed.

As stated above, other electric railways have been constructed; but this is given as a typical one, and as one in which considerable difficulties have been overcome.

We shall look forward to the time when electric railways will be as common as, perhaps, any other mode of travelling.

LIFE IN OTHER WORLDS.

By RICHARD A. PROCTOR.

(*Continued from p.* 211.)

AGAIN, if we compare any two members of the solar system, except perhaps Venus and the Earth, we cannot doubt that the duration of any given stage of the existence of one must be very different from that of the corresponding stage in the other. If we compare, for instance, Mars with the Earth, or the Earth with Jupiter, and still more, if we compare Mars with Jupiter, we cannot doubt that the smaller orb of each pair must pass much more rapidly through the different stages of its existence than the larger. The laws of physics assure us of this, apart from all evidence afforded by actual observation; but the results of observation confirm the theoretical conclusions deduced from physical laws. We cannot, indeed, study Mars in such sort as to ascertain his actual physical condition. We know that his surface is divided into lands and seas, and that he possesses an atmosphere; we know that the vapour of water is at times present in this atmosphere; we can see that snows gather over his polar regions in winter and diminish in summer: but we cannot certainly determine whether his oceans are like our own, or for the most part frozen; the whitish light which spreads at times over land or sea may be due to clouds or to light snow-falls, for aught that observation shows us; the atmosphere may be as dense as our own or exceedingly rare; the polar regions of the planet may resemble the earth's polar regions, or may be whitened by snows relatively quite insignificant in quantity. In fine, so far as observation extends, the physical condition of Mars may closely resemble that of the earth, or be utterly dissimilar. But we have indirect observational means of determining the probable condition of a planet smaller than the earth, and presumably older—that is, at a later stage of its existence. For the moon is such a planet, and the telescope shows us that the moon in her decrepitude is oceanless, and is either wholly without atmosphere or possesses an atmosphere of exceeding tenuity. Hence we infer that Mars, which, as an exterior planet, and much smaller than the earth, is probably at a far later stage of its existence, has passed far on its way towards the same state of decrepitude as the moon. As to Jupiter, though he is so much farther from us than Mars, we have direct observational evidence, because of the vast scale on which all the processes in progress on his mighty globe are taking place. We see that his whole surface is enwrapped in cloud-layers of enormous depth, and undergoing changes which imply an intense activity (or, in other words, an intense heat) throughout his whole mass. We recognise in the planet's appearance the signs of as near an approach to the conditions of the earth when, as yet the greater part of her mass was vaporous, as is consistent with the vast difference necessarily existing between two orbs containing such unequal quantities of matter.

Mars, on the one hand, differs from the earth in being a far older planet—*probably*, as respects the actual time which has elapsed since the planet was formed, and *certainly* as respects the stage of its career which it has now reached. Jupiter, on the other hand, differs from the earth in being a far younger planet—not in years perhaps, but in condition. As to the actual age of Jupiter we cannot form so probable an opinion as in the case of Mars. Mars being an exterior planet, must have *begun* to be formed long before the earth, and, being a much smaller planet, was probably a shorter time in attaining its mature growth. On both accounts, therefore, he would be much older than the earth in years; while, as we have seen, his relative smallness would cause the successive stages of his career subsequent to his existence as an independent and mature planet to be much shorter. Jupiter, being exterior to Mars, presumably began to be formed millions of centuries before that planet, but his bulk and mass so enormously exceed those of Mars, that his growth must have required a far longer time; so that it is not at all certain that even in point of years Jupiter (dating from his maturity) may not be the youngest member of the solar system. But even if not, it is practically certain that, as regards development, Jupiter is far younger than any member of the solar system, save perhaps his brother-giant Saturn, whose greater antiquity and inferior mass (both suggesting a later stage of development) may have been counterbalanced by a comparative sluggishness of growth in the outer parts of the solar domain.

It is manifest from observed facts, in the case of Jupiter, that he is as yet far removed from the life-bearing stage of planetary existence, and theoretical considerations point to the same conclusion. In the case of Mars, theoretical considerations render it extremely probable that he has long since passed the life-bearing stage,

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and observed facts, though, they do not afford strong evidence in favour of this conclusion, suggest nothing which, rightly considered, is opposed to it. It is true that, as we have shown in former essays on this planet, Mars presents many features of resemblance to our earth. This planet rotates in a period not differing much from our day; his year does not exceed ours so greatly as to suggest relations unpleasantly affecting living creatures; it has been shown that there are oceans on Mars, though it is not quite so clear that they are not for the most part frozen; he has an atmosphere, and the vapour of water is at times present in that atmosphere as in ours; clouds form there; snow falls, and perhaps rain from time to time; ice and snow gather at the poles in winter, and are partially melted in summer; the land surface must necessarily be uneven, seeing that the very existence of continents and oceans implies that once, at any rate, the globe of Mars was subjected to forces resembling those which have produced the irregularities of the earth's surface; glacial action must still be going on there, even if there is no rainfall, and therefore no denuding action corresponding to that which results from the fall of rain on our terrestrial continents. But it is a mistake (and a mistake too commonly made) to suppose that the continuance of those natural processes which are advantageous to living creatures, implies the existence of such creatures. The assumption is that the beneficent processes of nature are never wasted according to our conceptions. Yet we see over and over again in nature not merely what resembles waste, what in fact *is* waste according to our ideas, but an enormous excess of wasted over utilised processes. The sun pours forth on all sides the supplies of light and heat which, where received as on our earth, sustain vegetable and animal life; but the portion received by our earth is less than the 2,000 millionth, the portion received by all the planets less than the 230 millionth part, of the total force thus continually expended. And this is typical of nature's operations everywhere. The earth on which we live illustrates the truth as clearly as the sun. We are apt to say that it teems with life, forgetting that the region occupied by living creatures of all orders is a mere shell, while the whole interior mass of the earth, far larger in volume, and undergoing far more active processes of change—teeming in fact with energy—contains no living creature, or at least can only be supposed to contain living creatures by imagining conditions of life utterly different from those we are familiar with.

The mere continuance, therefore, on Mars of processes which on the earth we associate with the existence of life, in reality proves nothing as to the continued existence of life on Mars. The surface of the moon, for example, must undergo disturbances,—mighty throes, as the great wave of sun-distributed heat circles round her orb once in each lunation,—yet few suppose that there is life, or has been for untold ages, on the once teeming surface of our companion planet. The formation of Mars as a planet must so long have preceded that of our earth, his original heat must have been so much less, his small globe must have parted with such heat as it once had so much more rapidly, Mars lies so much farther from the sun than our earth does, his atmosphere is so much rarer, his supply of water (the temperature-conserving element) is relatively as well as absolutely so much smaller, that his surface must be utterly unfit to support life in the remotest degree resembling the forms of life known on earth (save, of course, those lower forms which from the outset we have left out of consideration). Yet at one time, a period infinitely remote according to our conceptions of time, the globe of Mars must have resembled our earth's in warmth, and in being disturbed by the internal forces which cause that continual remodelling of a planet's surface without which life must soon pass away. Again, in that remote period the sun himself was appreciably younger; for we must remember that although, measured by ordinary time-intervals, the sun seems to give forth an unvarying supply of heat day by day, a real process of exhaustion is in progress *there* also. At one time there must have existed on Mars as near an approach to the present condition of our earth, or rather to her general condition during this life-supporting era of her existence, as is consistent with the difference in the surface gravity of the planets, and with other differences inherent as it were in their nature. Since Mars must also have passed through the fiery stage of planetary life, and through that intermediate period when, as it would seem, life springs spontaneously into being under the operation of natural laws not as yet understood by us, we cannot doubt that when his globe was thus fit for the support of life, life existed upon it. Thus for a season, — enormously long compared with our ordinary time-measures, but very short compared with the life-supporting era of our earth's career,—Mars was a world like our own, filled with various forms of life. Doubtless, these forms changed as the conditions around them changed, advancing or retrograding as the conditions were favourable or the reverse, perhaps developing into forms corresponding to the various races of men in possession of reasoning powers, but possibly only attaining to the lower attributes of consciousness when the development of life on Mars was at its highest, thenceforth passing by slow degrees into lower types as the old age of Mars approached, and finally perishing as cold and death seized the planet for their prey.

In the case of Jupiter, we are guided by observed facts to the conclusion that ages must elapse before life can be possible. Theory tells us that this mighty planet, exceeding the earth three hundred times in mass, and containing five-sevenths of the mass of the whole system of bodies travelling around the sun, must still retain a large portion of its original heat, even if we suppose its giant orb took no longer in fashioning than the small globe of our earth. Theory tells us, moreover, that so vast a globe could not possibly have so small a density (less than one-fourth the earth's) under the mighty compressing force of its own gravity, unless some still more potent cause were at work to resist that tremendous compression—and this force can be looked for nowhere but in the intense heat of the planet's whole mass. But observation shows us also that Jupiter is thus heated. For we see that the planet is surrounded by great cloud-belts such as our own sun would be incompetent to raise,—far more so the small sun which would be seen in the skies of Jupiter if already a firmament had been set "in the midst of the waters." We see that these belts undergo marvellous changes of shape and colour, implying the action of exceedingly energetic forces. We know from observation that the region in which the cloud-bands form is exceedingly deep, even if the innermost region to which the telescope penetrates is the true surface of the planet—while there is reason for doubting whether there may not be cloud-layer within cloud-layer, to a depth of many thousand miles,—or even whether the planet has any real surface at all. And, knowing from the study of the earth's crust that for long ages the whole mass of our globe was in a state of fiery heat, while a yet longer period preceded this when the earth's globe was vaporous, we infer from analogy that Jupiter is passing, though far more slowly, through stages of his existence corresponding with terrestrial eras long anterior to the appearance of life upon the scene.

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We must, then, in the case of Jupiter, look to a far distant future for the period of the planet's existence as a life-sustainer. The intense heat of the planet must in course of time be gradually radiated away into space, until at length the time will come when life will be possible. Then, doubtless, will follow a period (far longer than the life-sustaining portion of the earth's existence) during which Jupiter will in his turn be the abode of life. It may be that before then the sun will have lost so large a proportion of heat that life on Jupiter will be mainly sustained by the planet's inherent heat. But more probably the changes in the sun's heat take place far more slowly than the changes in the condition of any planet, even the largest. Possibly, even, the epoch when Jupiter will be a fit abode for life, will be so remote that the sun's fires will have been recruited by the indrawing of the interior family of planets. For it must be remembered that the periods we have to deal with in considering the cooling of such an orb as Jupiter are so enormous, that not merely the ordinary time-measures, but even the vast periods dealt with by geologists must be insignificant by comparison. Yonder is Jupiter still enwrapped in clouds of vapour raised by his internal heat, still seething, as it were, in his primeval fires, though the earth has passed through all the first stages of her existence, and has even long since passed the time of her maturity as a life-sustaining globe. It is no mere fancy to say that all the eras of Jupiter's existence must be far longer than the corresponding terrestrial eras, since we actually see Jupiter in that early stage of his existence and know that the earth has passed through many stages towards the final eras of decay and death. It is, indeed, impossible to form any opinion as to the probable condition of the sun or of the solar system when Jupiter shall become fit to support life, seeing that, for aught we know, far higher cycles than those measured by the planetary motions may have passed ere that time arrives. The sun may not be a solitary star but a member of a star-system, and before Jupiter has cooled down to the life-sustaining condition, the sun's relation to other suns of his own system may have altered materially, although no perceptible changes have occurred during the relatively minute period (a trifle of four thousand years or so) since astronomy began.

(To be continued.)

CHAPTERS ON MODERN DOMESTIC ECONOMY.

XX.—THE FRAMEWORK OF THE DWELLING-HOUSE.

STRUCTURAL EXAMPLES (*continued*).

THE DISPOSAL OF HOUSEHOLD REFUSE.

IN conjunction with the earth-closet system, a novel mode of dealing with liquid waste, so as to meet the requirements of large towns, has been adopted by Messrs. Lawson & Donkin, of Bournemouth. Mr. Donkin's invention has been aptly termed the "The Patent Combination Earth and Water-Closet." By means of this apparatus the liquid excreta, which usually accompanies each dejection, is made to pass into a separate receptacle from that for the semi-solid soil, and is conveyed away into the drain-pipes, or may be collected in reservoirs for future treatment. The woodcut, Fig. 11, shows that it consists of a basin, A, with two sub-divisions. The foremost of these, C, forms a urinal, whilst the nether compartment, B, is a pan for the reception of the soil. The action of the seat serves to turn the earth-valve, D, and thus to shoot out a charge of earth into the soil-receptacle, A; whilst an ordinary pull-up handle, dotted in the figure, performs the double duty of discharging the pan and flushing the urinal. The entire

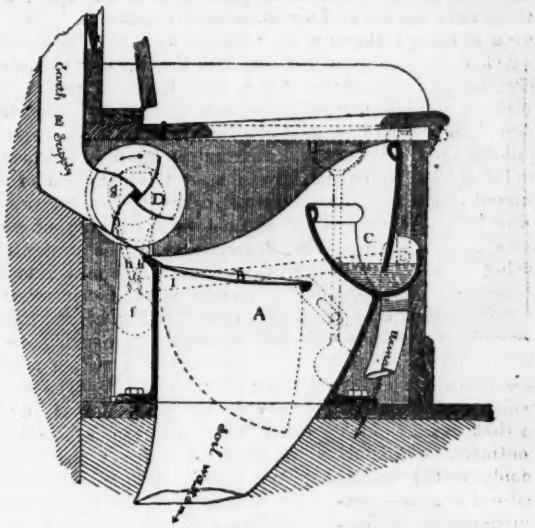

Fig. 11.

device is a mechanical masterpiece; it is quite original, it thoroughly fulfils the objects of the designer, and compares favourably in price with either water-closet furniture or other apparatus of its kind.

We now come to the last and, from a combined utilitarian and sanitary point of view, the best form of dry closet hitherto introduced; inasmuch as it combines the several apparatuses required for drying, sifting, and applying the corrective re-agent, in a simple and strong automatic whole, which is not only quite effective, but labour-saving, and thus overcomes the chief difficulty with regard to the working of the dry system. It uses one kind of household refuse—fine ash-dust—to destroy the pernicious influences of excrement, and in doing so, produces a saleable commodity of the highest value to the agriculturist.

We have already demonstrated the difference between fire-place waste, consisting, as it does, of unconsumed fuel and ash-dust, and the ash-dust alone, as correctives to decomposition, and we pointed out that the difference between the indiscriminate use of the former and the intelligent separation of the latter constitutes the line of demarcation between a midden, movable or unmovable, on the one hand, and a closet on the other. This distinction serves to distinguish Mr. Morrell's apparatus as a closet, because a specially-prepared re-agent—sifted ash-dust—is used.

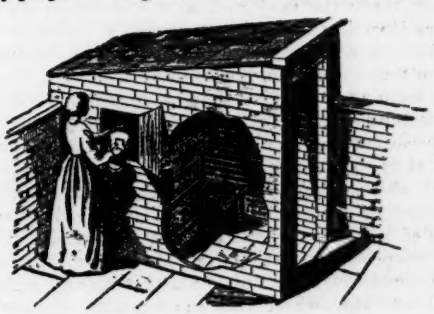

Fig. 12.

All the labour that is necessary to set the apparatus in good working order is shown by Fig. 12. The servant is

here engaged in throwing house-sweepings and fireplace refuse into an outhouse window. There her duty ends; a duty which perforce must be performed in any case; and there does the work of the automaton commence. Fig. 13 is a sectional drawing of "Morrell's Patent Self-acting Cinder-sifting Ash Closet," or "Combined House Ashes and Earth Closet." The second title here quoted is only very seldom appropriate, viz, at such times as the ash-dust from the house is insufficient in quantity to meet the demands of the closet, when it can be supplemented by a quantity of dried loamy earth. The contents of the servant's pail falls into the place marked "unscreened ashes" in Fig. 13, and thence through the opening on to the top of a sifting screen, shown above the part marked "ash-dust." The action of the seat on rising moves the lever, dotted in the figure, which in its turn tilts up the ash-dust receptacle, and, in doing so, sifts the refuse; the cinders fall off the inclined plane into a box below, marked "cinders" in the figure, whilst the ash-dust, deprived of all large particles, enters the receptacle prepared for it. At the same time the tilting of the ash-box causes a fixed quantity of the ash-dust to be discharged into a terminal spoon, which acts as a distributor, and spreads the reagent evenly over the soil. The cinders may be removed from time to time through a side-door shown in Fig. 14, whilst the soil-pail is capable of being taken out in the same way. Fig. 14 shows a compact form which may with advantage be placed in a bath room or upstairs compartment; slightly modified, it forms a handsome piece of furniture for a bed-room or sick-room commode, whilst the cost of even the most expensive form is so low, that it could be adopted in the houses of the poor. The absorbent and deodorising properties of coal ash-dust, freed from cinders, are such as to place it in the first rank of dry-closet re-agents. We have subjected it to severe tests, and find from our experiments that it is quite efficacious. Its admixture with the soil in the production of a valuable manure we have already referred to at length in a former paper.*

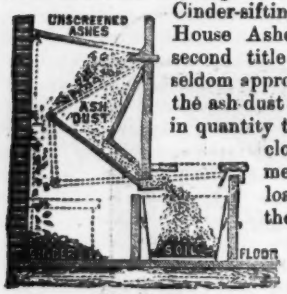

Fig. 13.

Fig. 14.

The treatment of liquid waste by the ash-closet system has been made the subject of a new invention by Mr. J. Conyers Morrell, and he has succeeded so perfectly in this that the only obstacle to the introduction of his appliance in large towns has been finally overcome. The apparatus was exhibited for the first time on March 2, 1885, at the Architectural and Building Trades Exhibition. It is subsidiary to the closet appliance, and consists of a galvanised iron tank, in the shape of a semi-cylinder on wheels, the ends of which are closed. The compartment thus formed is divided by a partition, as shown in Fig. 15, the basal moiety of which is perforated. The first chamber acts as a soil-receptacle, whilst the sifted cinders fall into the second division. Excess of liquid that may by accident be poured into the soil-receptacle and remain unabsorbed by the ash-dust, or the liquid waste from nursery chambers, passes into the cinder-containing division. All bedroom and other house-slops may be poured into a basin leading to the cinder trough, which thus acts as a preliminary and constantly renewed filter. The liquid thence passes out through a pipe from that trough, the proximal portion of which is detachable, and filled with a prepared granular carbon; this acts as a second and more perfect filter; and the effluent, tolerably purified and innocuous, may thence be discharged into the gully for sink-water, and thus into the surface drains, or may be used for purposes of irrigation. In the suburbs of London, and especially in country towns, villages, and isolated farmsteads and mansions, the cinders may be shunted into a side box, and all the liquid waste from the second receptacle pass unfiltered into pipes leading to the loose drains of gardens and arable land; the immediate result of this would be an increased and rich harvest.

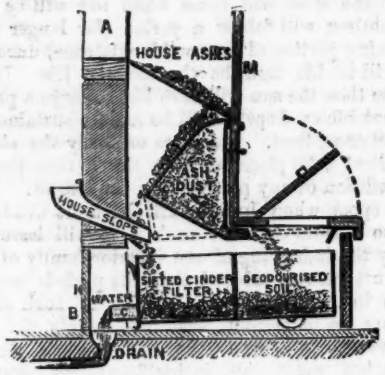

Fig. 15.

We have now shown, that through these modern improvements, the dry system for the disposal and utilisation of household refuse has reached a stage at which it can be profitably employed, not only in country villages, but even in large towns; and it only now remains for our local suburban boards to adopt the system, in order to ensure the happy results of freedom from preventible disease, decrease in the rates and taxes, healthy homes for the poor, and the enrichment of the soil.

THE NICARAGUA CANAL PROJECT.*

THE idea of a ship canal across Nicaragua, which should utilise both the San Juan and Del Medio rivers and Lake Nicaragua, is over a century old. Long before the formal conclusion of hostilities between Great Britain and the revolted colonies which were soon to become the United States, two colonels of the British army made a secret survey of the routes possible, and in 1870, Captain, afterwards Lord, Nelson attempted to seize the country, with a view to a ship canal in the near future. During the succeeding seventy years the Cabinets of Westminster and Washington found in this Nicaragua project their most fruitful subject for diplomatic bickering—until, in fact, the Crimean War and the Mutiny on the one hand, and the great conflict with the Confederate States on the other, diverted English and American attention to more urgent matters. Now, after the last serious movement towards constructing such a canal by private enterprise has been

* KNOWLEDGE, Dec. 26, 1884, pp. 523, 524.

* This article from our valued contemporary *Engineering*, is inserted as a fitting supplement to that finished in last week's KNOWLEDGE, on the Tehuantepec Ship Railway.

dead for a quarter of a century, the United States Government revivifies the subject by a proposition to build, pay for, and maintain a ship canal from Greytown to Brito, and a treaty with Nicaragua providing for this is before the Senate of the United States for confirmation.

The questions raised or suggested by the old project in this new form—the feasibility of the plan, its probable cost, when it can be completed, the engineering and climatic difficulties to be surmounted, its effect upon the rival schemes at Panama and Tehuantepec, the prospects it opens to the business world, the political complications it may involve—are as interesting as they are numerous.

The plan proposed is that of A. G. Menocal, civil engineer of the United States Navy, who has been for years deeply interested in the subject, and who is now on the ground with a party sent by the American Government, making the final surveys. The canal is to have for its Atlantic terminus the little city of San Juan de Nicaragua, or Grey Town. Thence a cut less than twenty miles through easy, level country will bring the works to the San Juan river, intersecting it at a point just above the Rio Colorado. The remainder of the San Juan will be utilised up to its source, Lake Nicaragua, and then the course will be straight across that body of water to the mouth of the Del Medio river. Thence a cut of 16·33 miles brings it to the waters of the Pacific. The entire length of the canal, as proposed, is 181·26 miles, and of this 119·52 miles will be by lake or slack water. The engineering difficulties, which are by no means extraordinary, will, of course, be found in the remaining 61·74 miles of canal proper. In ascending the San Juan valley after the river is reached, four dams in the river will be needed, and three short stretches of canal must be dug to get around rapids, the entire length of which will be 3·51 miles. These, however, and the locks they involve, present no specially arduous problems. It is when the farther side of the lake is reached, and the task of getting down 134 ft. within seventeen miles, through a mountainous range, is confronted, that the real work begins. Here there must be at least eight locks, and for the first five miles from the lake towards the Pacific the cut necessary in the average will be over 100 ft. Thence onward to the coast the work will be much lighter. At their very worst, these obstacles to be overcome are small and simple in comparison with the tasks at which M. Lesseps' engineers are toiling 300 miles further south, and the scientific sponsors of the Nicaragua plan laugh at them as bagatelles. The work outlined above being done, nothing remains but to fashion the little bay at Brito into a harbour, and dredge out the harbour at Greytown. Twenty-five years ago the latter was deep and good, but has latterly become choked by deposits from the San Juan river. This sediment, however, comes from the portion of the river below the point where the canal is to tap it, and, once the harbour is cleaned, it will be easy to stop the silt deposit by closing the old mouth of the stream. The harbour works on both sides will be extensive and moderately costly, but not difficult.

The whole question of cost is dealt with in figures so small, compared even with those which Paris stockholders have already heard, to say nothing of those which soon must come to their ears, that the marvel goes in studying them that the canal they represent was not built long ago. The lowest estimate of expense is that of Mr. Childs, one of the best engineers of his time, who conducted the surveys of thirty odd years ago, and who reported that the work would cost £9,000,000. The present outside estimate of Mr. Menocal is £13,000,000. Some of its other advocates place the maximum cost at £16,000,000, but that is the limit. Assume, as the Americans have generally in canvassing the subject, that £20,000,000 will, in round numbers, be required before the work is completed, and there is still a very striking difference between this Nicaragua project and the Panama Canal.

This difference in cost is only one of many advantages that the northern route seems to possess over M. de Lesseps' scheme, but it is the most conspicuous. The great French promoter announced in 1880, before the Panama stock was offered in the market, that the contracts had all been entered into to construct the canal for 500,000,000 francs (£20,000,000). In September last the fourth issue of bonds was made, representing an aggregate sum of 768,693,500 francs, and 30,497,740 francs interest, and yet this indebtedness, in itself £7,000,000 above what was to be the entire cost of the canal, finds the work of digging advanced one-fifth towards completion, with the chances of a constant increase in the expenses as the years go on. To be sure, the estimates of cost in the Nicaragua scheme are nothing but estimates, but they are the results of twenty surveys, and of the serious studies of many experts, who have given years to the work, whereas M. de Lesseps made his figures with a light heart, after a somewhat sanguine investigation of the ground.

One important feature in the cost of the Panama work, and a most threatening element in its future, if it is to have any future, is, of course, the excessive rainfall, and the tendency of the Chagres river to violent freshets. At the Paris Canal Congress, it was shown that even a dam along the most dangerous part of the river, over a mile long and 140 ft. high, would not certainly protect the canal from ravages by flood, yet this only tolerable guarantee would cost £6,000,000. What it will really cost to guard the Panama Canal effectively from this peril, if indeed it can be done at all, no one knows, and, thus far, no attempt has been made to determine. There is no such trouble in Nicaragua, where the climate is equable, and the rainfall as moderate as it is in Italy. This leads naturally to the consideration of the relative healthfulness of the two sections. Remarks upon the healthfulness of Panama may be as brief as the historic chapter on snakes in Ireland. It is the pest-house of the world. But a single illustration is needed to show the difference. Of the thirty-two persons who accompanied Dingler to Panama, only twenty were alive at the beginning of the second year, and hundreds of the officials and workmen on the canal have died annually. Of all the engineers, experts, and workmen, who at one time and another have surveyed the Nicaragua route, not one suffered physically from the experience. Nicaragua's mortality list is considerably below the average of tropical countries; that of Panama is far and away the highest known.

Of great importance, too, are the facts that all the material necessary for construction of locks, dams, &c., as well as for the maintenance of the force engaged in the work, are close at hand in Nicaragua, which is not the case at Panama; and that this northern canal would not merely furnish a short cut to the Pacific, but would open up for trade, immigration, and investment a fertile and naturally wealthy country. To conclude, the Nicaragua Canal can be built within five years, or long before the Panama Canal is finished.

The single objection to the project is that it involves at least eleven locks—and, no doubt, at first glance, the Panama dream of a sea-level channel, with only one tide-lock, is much more alluring. But there are other things to be considered, not least among them the fact that tolls on the Nicaragua Canal can be cut much below half the Panama charges, and bear the same relation to the invest-

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ment. Then, again, the records of the largest lock in the world, that in the St. Mary's Falls Canal (80 ft. wide, 515 ft. beween gates, 18 ft. lift), show the average time in locking vessels through to be seventeen minutes, or, with five minutes for clearing the lock approaches, twenty-two minutes. With improved appliances the time could be still further reduced, but allow a full thirty minutes, and forty-eight vessels could be passed in a day; giving them an average of only 2,000 tons, and counting but 300 transit days, we have a possible annual passage of 28,800,000 tons. The Suez Canal in 1883 passed 8,000,000 tons, and paid handsomely. As for the other time consideration, that of delay in the voyage, the matter of six or eight hours to be taken up in locking through, would be more than offset by the absence of trade winds off the Atlantic Panama coast.

As for the profits, it has long been apparent that one canal across the neck between the Americas would pay. If there were to be no rival, the Nicaragua Canal would rival the Suez as an investment. If there are to be two—and if the credulity of Parisian speculators and investors holds out, this contingency will some time or other become a certainty—it is a nice question whether one would kill the other, or there be business enough for both. Starting upon the fair basis that the Nicaragua Canal will have to earn on an investment one-third that of Panama, and that her lockage is offset by the latter's combined absence of trade-winds and prevalence of contagion as disadvantages, it can be seen that the former has the odds on its side. The promoters of the Panama Canal talked about 6,000,000 tons annually at 12s. per ton, and a net annual profit of £2,200,000. The Menocal estimates have been based on 3,000,000 or 4,000,000 tons, and a much smaller charge. It is very difficult to safely estimate the tonnage which such a canal would attract, for it would create trade as well as divert it. But, as the bulk of this trade would of necessity be American, in the sense of being either bound to or from an American port, the fact that the Nicaragua route is much nearer the States than the other, would surely weigh, especially when it ran in the line of economy. Captain Eads based his Tehauntepec ship-railway upon this idea of getting as near as possible to the United States, and withdrew the Bill for it from Congress as soon as the Nicaragua treaty was broached, because he saw in the latter a rival for the American trade which he did not fear at Panama. This is in itself distinguished testimony to the value of the idea that the strictly American trade would go to Nicaragua as against Panama. The grain product shipped from the Pacific States to Europe is 2,000,000 tons alone, and the vessels going for this product, in ballast or with coal and iron, make another million. It is safe to rate the whole trade at 4,000,000 tons, perhaps, and if the canal get this at 8s., there would be a revenue of £1,600,000, or say, after deducting expenses, a round £1,000,000 on an investment of £20,000,000. After this, which gives a fair five per cent., what is there left for the Panama Canal, if the two are in rivalry? England will have her great trade with the Pacific side of South America, first of all, and then her route to New Zealand will be shortened by 1,500 miles. From London to Sydney, however, will be 12,500 miles by the isthmus, against 11,500 *viâ* Suez, so that the canals will not greatly affect, certainly not revolutionise, our Australasian lines of communication. If all our tonnage to the Peru-Chili coast and to New Zealand, Hawaii, &c., sought out M. de Lesseps' canal, and was followed by every other merchant flag of Europe bound for those waters, the aggregate would not reach 4,000,000 tons. If the Panama Canal passed this tonnage annually at 8s. it could not pay expenses and interest. If it charged double that rate, as would be necessary to get a dividend—why then this tonnage too would go to Nicaragua.

It was the consciousness of this which led to the tumble of Panama stock, and the anxious rush to unload it on the Bourse, when the news of the Nicaraguan treaty reached Paris. For, by all human rules, a Nicaragua Canal means bankruptcy to a Panama Canal—particularly to such a Panama Canal as we are like to have—and if even the French capitalists who have been led by M. de Lesseps into the morass can see this, it ought to be tolerably clear to the rest of the world. There is no probability either of France lending official aid, financial or otherwise, to the scheme, for M. Ferry has quite enough demands upon his courage and credit, without seeking fresh trouble gratuitously elsewhere.

FIRST STAR LESSONS.

By Richard A. Proctor.

THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct) :—

1. *Ursa Minor*, the *Little Bear* (*a*, the *Pole Star*).
2. *Draco*, the *Dragon* (*a*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*a*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*a*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*a*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*a*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*a*, *Vega*).
15. *Cygnus*, the *Swan* (*a*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*a*, *Aldeburan*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*a*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*a*, *Regulus*).
24. *Virgo*, the *Virgin* (*a*, *Spica*)
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*a*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*a*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*a*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*a*, *Alphard*).
36. *Crater*, the *Cup* (*a*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*a*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*a*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*a*, *Sirius*).
45. *Argo*, the *Ship*.

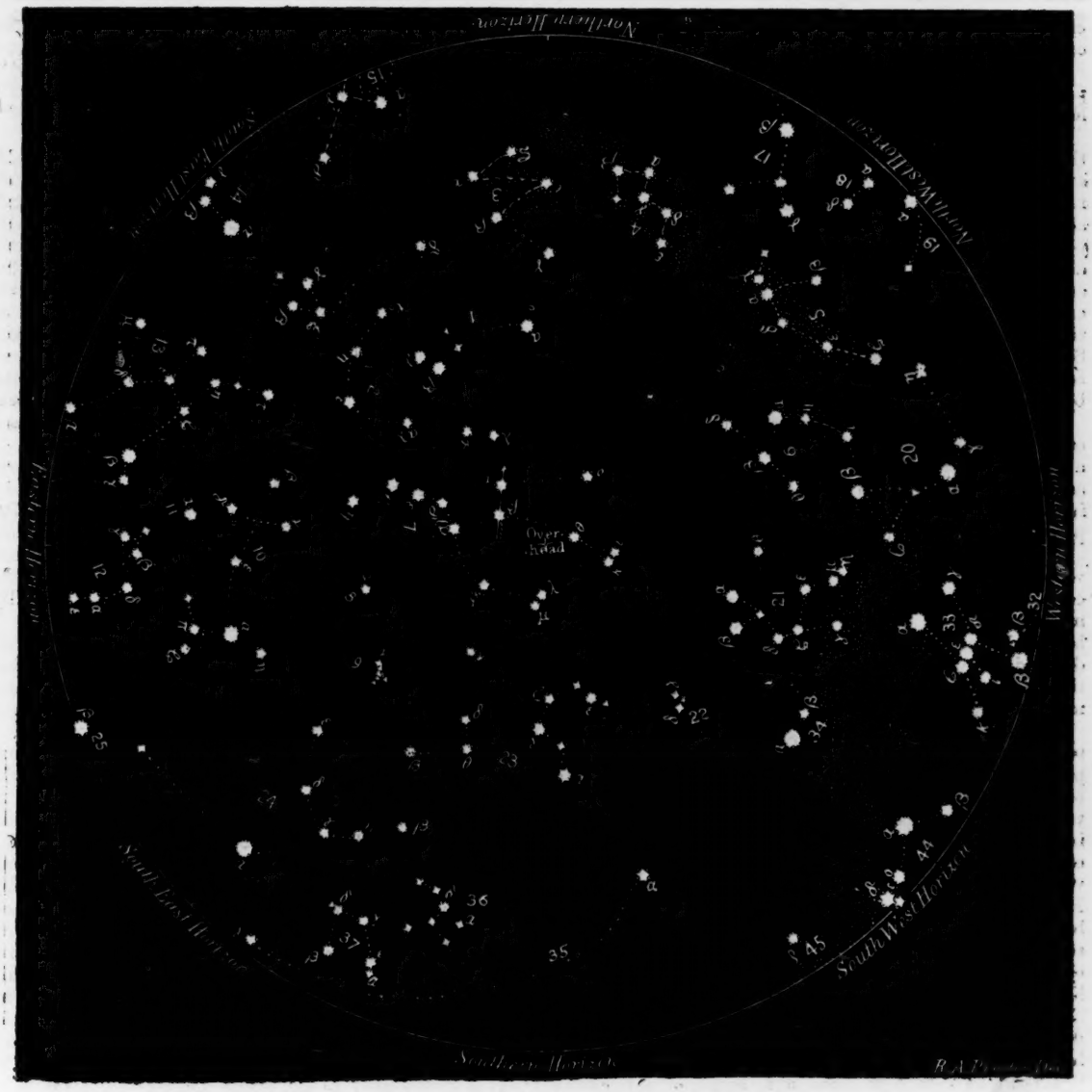
THOUGHT AND LANGUAGE.

By Ada S. Ballin.

VI.

I HAVE already pointed out as briefly and clearly as possible that the origin of gesture may be found in the outward manifestation of feeling, and have glanced at the origin of emotional expressions.

Animals of every form of life transmitted to their offspring their own physical conditions, and with them necessarily their sensations. These inherited sensations would naturally produce under similar conditions similar mani-



NIGHT SKY FOR MARCH (Second Map of Pair),

Showing the heavens as they appear at the following hours:—

March 25 at 10 o'clock. | March 29 at 9¾ o'clock. | April 1 at 9½ o'clock.

festations which might, therefore, be considered as instinctive.

Some writers, however, have tried to prove that gesture is wholly imitative; but such an hypothesis is most unsatisfactory.

In the lower animals gestures expressive of feeling in common with other instincts are developed so early that the possibility of their arising from imitation is almost precluded, and the hypothesis receives its death-blow when we find gestures of this class performed by those in whom imitation had been rendered impossible by circumstances. A very notable example of this is afforded by the case of Laura Bridgeman, who was quite blind, as well as deaf and dumb. She would laugh, clap her hands, and stamp for joy; blushed; wept for sorrow. When, by means of touch and the deaf-and-dumb finger-language, she was told anything ludicrous, she assumed a roguish expression, biting her lips with an upward contraction of the facial muscles as is observed in ordinary persons trying to suppress a laugh. When exonerating herself from blame, she would shrug her shoulders, turn in her elbows, and raise her eyebrows—that characteristic group of gestures most familiar to us as made by French and Italians. She was observed to use many other expressions and gestures which could not possibly have been imitative, owing to her unfortunate condition.

As already remarked, it is as expressing emotions that voice for the first time comes into play. It is a usual concomitant of facial and other expressive movements, and in a measure supplements them in the language of signs, by

calling another sense to its aid, so that emotions may be comprehended equally well by sight or hearing.

The character of the voice alters in loudness, quality, and pitch according to varying emotions. This is so in the lower animals, and in man from a very early age.

Musical notes are uttered by many animals. Darwin says that one of the gibbons produces an exact octave of sounds, ascending and descending the scale by semitones. Romanes remarks, that, although there is no evidence that any other animal except the *hylobates agilis* has a delicate sense of pitch, "I have heard a terrier, which used to accompany a song by howling, follow the prolonged notes with some approximation to unison, and Dr. Huggins, who has a good ear, tells me that his large mastiff, 'Kepler,' used to do the same to prolonged notes sounded from an organ."* Some rodents also are able to produce correct musical sounds, and an account is given of a singing hesperomys, by the Rev. S. Lockwood.†

Variations of voice are interpreted in the same way as other actions expressive of feelings; they are instinctive and involuntary. For as the expressions of the feelings are instinctive, they are instinctively understood by the individual in reference to his own feelings, as far as he posse-ses the emotions from which they spring.

Monkeys, according to Rengger, distinguish the tones of voice and the facial expressions of their masters. This is certainly the case with the dog, who knows when his master is pleased or angry, understands when he chides him, and expresses sympathy when he is sorrowful. The dog understands a compassionate tone and bearing so well that he will sometimes try to impose on those who manifest it.

A friend of mine has a splendid Newfoundland, which suffered some months ago with rheumatism in one of its paws. During its illness it was much petted, and treated to many unusual delicacies, and it now frequently pretends to be ill in the hope of obtaining by this means similar indulgences. Having been told of this I assumed an expression of great pity, and said in a compassionate voice, "Poor Jumbo! I'm afraid he's not at all well. He must have some cake." The dog at once lay down on his side, holding up the paw in which he had previously suffered, and moaned in a heart-rending fashion. His total change of demeanour was so sudden that I could not help laughing at the artfulness of his ruse.

This same dog has the emotion of compassion strongly developed in himself, and has more than once brought a half-starved mongrel home to have it fed.

I shall have further occasion to speak of my canine friend, Jumbo, when discussing the question of how far the lower animals are capable of understanding words as such; but that they understand the expression of emotions by gesture and voice, both in animals of their own and other species, as well as in man, is so obvious to all who come in contact with them, as to render discussion of the point unnecessary. I may, however, refer to an interesting case quoted by Romanes‡ from a writer in *Nature*, who kept a number of gibbon apes (*hylobates agilis*) in his garden. He says:—"These live free from all restraint in the trees, merely coming when called to be fed. . . . And I have frequently noticed that a cry of fright, pain, or distress from one would bring all the others at once to the complainer, and they would then condole with him, and fold him in their arms."

If we look on the other side of the picture, we find that in this respect man has a great advantage over the animals; for, while the lower animals do not possess a number of the emotions displayed by man, and the signs of these emotions are, therefore, meaningless to them, man possesses nearly, if not quite all, the emotions of which the lower animals are capable, and, being enabled to recognise them, can gain a greater insight into their inner life.

We recognise in animals anger, jealousy, envy, emulation, disappointment, grief, love, parental affection, sympathy, self-denial, joy, and many other emotions and shades of emotion more or less complex. We are even enabled to obtain a knowledge of the psychology of creatures so far removed from us in the scale of life as the earth-worm and the ant by observing certain manifestations in them about which we reason by analogy with our own mental processes. An extreme instance of this is given by Mr. Langshaft in his "Treatise on the Honey-Bee": "There is an air of roguery about a thieving bee which, to the expert, is as characteristic as are the motions of a pick-pocket to a skilful policeman. Its sneaking look and nervous, guilty agitation can never be mistaken.

An observation bearing on the subject of our comprehension of emotions in animals through voice was made by a correspondent in the *Daily Telegraph* for December 17th last, in the person of a Pomeranian. He says, "Shan can, however, argue, and does so in the most injured tones when he has been a 'bad dog' and we show him the stick. His voice rises and falls like that of a person wrongfully accused."

As a rule, people do not imagine what an important part emotional gestures, including voice and those other gestures of which I shall speak hereafter, play in language. This fact was very forcibly impressed upon me by a personal experience, which will serve as an illustration.

About a year ago a Russo-Jewish Opera Company was playing in England, and the editor of a paper, under the impression that the libretto would be in Hebrew, asked me for once to act as dramatic critic. My brother,* who is an excellent Hebrew scholar, accompanied me to the theatre. We soon found, however, that the play was not in Hebrew, but in a mixed jargon, of which we did not understand a dozen words throughout the five acts. Hence, in order to understand the play, we were reduced to the observation of voice and gestures; but our interest never flagged, and in a subsequent discussion we thoroughly agreed on every point in connection with the rather complicated plot. Without even knowing as much as the name of the language or dialect in which the play was spoken, I wrote a review of it, minutely describing the plot as it appeared to me, which, on inquiry, I found to be correct in every detail. Doubtless others who have witnessed plays in languages with which they were unacquainted will be able to corroborate our evidence on this subject.

Having now dealt rather fully with those gestures included in my first class, expressive of feeling, and with the interpretation of the same, I shall proceed in my next article to consider the other two classes of gestures—those which express Will and Thought.

The snow-storm which visited the South of England last Sunday morning caused very considerable damage to the telegraph and telephone wires. Wires were broken and poles were strained out of position in all directions, and but for the energetic action of those in charge of the system, an almost complete breakdown must have ensued. Of the London local telegraph wires, and those running from London southwards and westwards, about 150 were down. Wires going north suffered very lightly.

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* "Mental Evolution in Animals," p. 98.

† *American Naturalist*, Vol. V., December, 1871, p. 761.

‡ "Animal Intelligence," p. 473.

* Mr. F. L. Ballin, co-author with me of "A Hebrew Grammar, with Exercises." (Kegan Paul, Trench, & Co. 1881.)

Editorial Gossip.

HERR RUDOLPH FALB, of Vienna, who appears to be the author or promulgator of some new theory of earthquakes, is of opinion that explosions in mines are for the most part coincident with them. Regarding earthquakes as imminent on or about March 30, June 12, and July 12, he urges the observance of the greatest caution in mines about these dates. As to what Herr Falb's particular hypothesis may be, I am unfortunately ignorant, but as he has now afforded a crucial test of its truth by such very definite predictions as these, an excellent opportunity is afforded to physicists of testing its truth. *Ars probat artificem;* and we shall see—what we shall see. The one fact which, so far, seems tolerably well established in connection with the ghastly catastrophes which form the subject of the Austrian savant's prophecy is that they appear to be immediately sequent upon heavy falls of the barometer.

I NOTE that Wolf is about to commence a series of experiments at the Paris Observatory for the redetermination of the velocity of light. The type of apparatus to be employed by him is not stated. It will be curious and interesting to see how far his final results differ from the most trustworthy ones we now possess: I mean those derived from the delicate and almost exhaustive investigations of Cornu, in France, and Michelsen, in the United States.

THE eclipse of the sun on March 16 seems to have been very favourably observed in New York and other parts of the United States. The eclipse was an annular one, but as its central line passed considerably to the north of New York, it would obviously only be seen there as a partial one. The reader may determine the line of central eclipse approximately for himself by drawing one on a map of North America from Disco Island to the west of Greenland, across Hudson's Bay, and through Manitoba to Cape Mendocino, in California. This will give a rough idea of its path.

FROM the current number of *Ciel et Terre*, I learn that M. G. A. Hirn proposes to determine the temperature of the strata of the sun underlying the photosphere, in the following way:—According to an equation given by Weisbach, a direct relation exists between the initial temperature of a gas escaping from a reservoir into a region of less pressure, and the velocity of the gaseous particles. Now, Young and others have observed and approximately measured the stupendous and almost inconceivable velocity of the up-rush of some of the solar prominences, and from these data M. Hirn deduces the temperature of the region whence the gases composing them issued as 2,000,000° (presumably centigrade)!

THE same excellent little periodical also notes an attempt by le Père Thirion to account for the supposed satellite of Venus, which observers have from time to time imagined that they have seen, by the supposition that it is an image of the planet reflected from ice-crystals in the highest regions of the atmosphere. But, in æsthetic language, this is "too too"!

MARK TWAIN oracularly says, "You cannot bet anything on dreams." When I see it snowing heavily at the date of the equinox, it occurs to me that his remark would be equally applicable to our charming English climate.

EVERYONE who is anxious that Sunday should be really kept holy—in other words, should be devoted to the moral and intellectual advancement of the people—will rejoice at the result of the reception of the deputation of the Sunday Society by the trustees of the National Gallery on Tuesday week. The newspaper reports state that—

> Sir Henry Layard, on behalf of the trustees, expressed the pleasure they had had in receiving so influential a deputation, and amid great applause he stated that the trustees, having considered the request of the deputation, had by a majority come to the decision that the National Gallery ought to be opened on Sundays. The trustees, however, could not of their own action settle the matter, but if the House of Commons would express approval, the trustees would gladly see the Gallery open to the people on Sunday afternoons.

Hence it has come at last to a question of finance, and I am loth to believe that a Government which can squander money so indefensibly as it has been squandered many a time and oft at South Kensington, will refuse to devote an utterly insignificant annual sum to the provision of some counter attraction to the public-house; which is now offered as the sole alternative to church (or chapel) for the Sunday recreation of the working man.

SINCE the preceding paragraph was written the question has been discussed, on Lord Thurlow's motion, in the House of Lords, with the result that, on a division, the numbers were equal. Such a result in the teeth of the dead weight of professional opinion on the Episcopal Bench can have but one possible signification, the triumph of common-sense must be imminent.

I WOULD add one more notice here to the stereotyped ones at the head of our Correspondence Columns. It is this, and is addressed to the noble army of literary aspirants who persist in sending me bolsters of MSS. for insertion in the columns of KNOWLEDGE. I NEITHER CAN NOR WILL RETURN REJECTED LETTERS, ARTICLES, SKETCHES, OR ANYTHING ELSE, UNLESS THEY BE ACCOMPANIED BY ENVELOPES PROPERLY DIRECTED AND SUFFICIENTLY STAMPED.

IS THE CHRISTIAN DISPENSATION CLOSED?—I ask this question in all gravity. Some, when they hear of certain modern savageries, associated by many with glory (because of the "pomp and circumstance of glorious war"), are apt to ask somewhat sneeringly whether the Christian dispensation has begun. But I ask without any sneer if it has ended, simply because I find myself rather roundly denounced for saying that Professor Piazzi Smyth, and the Pyramidalists generally, announced the world's end about the year 1881; whereas, say his defenders, what he really referred to was the end, not of the world, but of the Christian dispensation. I am to infer, this being the case, that either the Pyramid prophecy has been misinterpreted (not to say that the whole idea of Pyramid prediction has been a wild and fanciful conception) or else that the Christian dispensation came to an end somewhere about the year 1881 or 1882. Now, I know that Professor Piazzi Smyth recognises in the events which have taken place in Egypt since 1881 the beginning of the end, and that when the comet of 1882 appeared he spoke as if the end of the world were actually at hand. But I had not supposed that even he imagined the end of the Christian dispensation had actually arrived. Of course, if the Pyramid Grand Gallery symbolises the Christian Dispensation, its length in Pyramid inches representing the duration of Christ's reign on earth in years, then the end of that kingdom must have arrived in 1882, since by no possible contrivance can the length of the gallery be made to represent more than 1,882 pyramid inches. But it would be well if the Pyramidalists could be persuaded to say which horn of the dilemma they prefer to sit on. Either the pyramid is not what they have so long asserted it to be—a miracle in stone—or else the reign of Antichrist began somewhere about the year 1882, at latest. *Utrum horum mavis accipe.*—R. A. PROCTOR, in *Newcastle Weekly Chronicle.*

Reviews.

SOME BOOKS ON OUR TABLE.

Astounding Modern Scripture Discovery. By John Wood. (Liverpool: Adam Holden.)—When we say that the author of this trash has previously published a work to show that the sun moves round the earth, and not the earth round the sun! and that hence "scientific opinion is a scientific fiction and nonentity," the reader will know pretty well what to expect. Mr. Wood's "Discovery" is that no rain fell before the Noachian Deluge. Is there no geological museum in Liverpool, or quarry near it, in which he can see fossil rain-prints in slabs of sandstone?

The Metaphysical Aspect of Natural History. By Stephen Monckton, M.D., F.R.C.P. (London: H. K. Lewis, 1885.)—With the purely theological part of Dr. Monckton's work we have no concern here. Drowning men catch at straws, and the possibility of the truth of apparitions, telepathy, and mesmerism is pressed by him into his argument. The major part of his little volume is Paley-and-water.

The Sun: a Familiar Description of his Phenomena. By the Rev. T. W. Webb, M.A., F.R.A.S. (London: Longmans, Green, & Co. 1885.)—In connection with astronomical literature there are few modern writers to whom Dr. Johnson's words concerning Goldsmith can be more appropriately applied than to Prebendary Webb; for, with regard to descriptions of the bodies which spangle the celestial vault, it may be in all sober truth said of him that "Nullum quod tetigit non ornavit." In his usual clear and pleasant style he discourses in the little book before us of the mighty ruler of our solar system, and briefly and popularly explains how its size, distance, and physical constitution have been determined. If we have met some of the engravings before, this scarcely detracts from their value as illustrations of the text. Mr. Webb's latest work should find a place upon the shelves of every young astronomer.

Studies in Microscopical Science. March, 1885. (London: Baillière, Tindall, & Cox).—Mr. Cole's "Studies" continue to justify the high opinion we have expressed of them on former occasions in these columns. Letterpress and illustrations are alike deserving of praise. Of the latter we may single out those of *Vaucheria racemosa* under a power of 300 diameters, and the foot of *Epeira diadema* × 74 (notably the latter), as life-like reproductions of the objects represented.

The Electrician's Directory. With Handbook for 1885. (London: George Tucker, *Electrician* Office. 1885).—This is the third year that this excellent directory has been issued, and, as might be expected, each year shows an improvement. A number of new tables have been given, interesting to those who are engaged in electrical pursuits. The list of local authorities and chief officers is more complete, and the list of alphabetical and classified names has been very largely increased. A totally new feature is to be found in the biographical section, in which a more or less brief biography is given of those whose names are best known in electrical pursuits. Several of these biographical sketches are accompanied by portraits, which, on the whole, are marvellously well done. The likeness is very striking, and we look for a considerable augmentation of this very attractive feature next year.

Waterside Sketches (cheap edition). By Redspinner (W. Senior). (London: Sampson Low, Marston, Searle, & Rivington.)—This delightful series of essays, issued now in a form and of a size that may be easily carried in the pocket, will be devoured by the enthusiastic angler, and will, in all human probability, convert every reader who may begin it in a condition of piscatorial nescience into a keen fisherman. A book to be recommended to all who love what is simple, pure, innocent, and natural.

Acetic Acid and Vinegar, Ammonia, and Alum. (London: J. and A. Churchill. 1885.)—This is one of a series of technological handbooks published by the Messrs. Churchill, and embodying an idea at once novel and excellent. The series is, in fact, intended "to meet the wants of those who, on account of the high price of an encyclopædia, are unwilling to purchase when they wish to consult but a small portion of it, and of others who seek for fuller information than can be found in works of such scope." Unquestionably, no cyclopædia with which we are familiar goes—or could go—into such minute and exhaustive detail on the subjects it comprises as does the work before us in connection with the four substances to which it is devoted. The student of chemistry, alike with the practical manufacturer, will find all that he needs to know about them between the two covers of the volume before us, so painstakingly and conscientiously edited by Mr. Gardner.

Go West. By Percy Taylor. (London: Wyman & Sons. 1885.)—Mr. Taylor's little book should be carefully read through from beginning to end by every intending emigrant who proposes to make Canada or the United States the land of his adoption. The author's own, obviously extensive, personal experience enables him to speak authoritatively on the subject on which he treats, and to give just the kind and amount of advice needed by all proceeding to a strange country. He gives details of the leading occupations likely to prove remunerative to the settler, and furnishes minute directions for his conduct on landing—where to go, what to buy, how to travel, and what to pay. Even the price of cigars is included among the items of information afforded. By wholly eschewing fine writing, and confining himself rigidly to his succession of necessary details, our author has contrived to pack a very large amount of instruction into a very small compass.

The March of the Strikers. By John A. Bevan, M.D. (London: W. Swan Sonnenschein & Co. 1885.).—If the Honourable Tarantula Degrumph is, in any sense whatever, drawn from life, Messrs. Hyndman & Co. need not denounce a monarchical country as the necessary home of "the bloated capitalist." The description of the hideous tyranny, and worse, which gave rise to "The March of the Strikers," is laid on with a four-pound brush in this curious novel. Were the old Victoria Theatre not now turned into a coffee and lecture hall, a dramatised version of Dr. Bevan's highly-spiced story would doubtless find immense favour with its quondam frequenters. Grit and Mother Weary, Degrumph himself, Blutgelt, Minnie and Ruth are essentially transpontine; while the street-fight between the strikers and the American troops and police would bring the house down.

We have also on our table *The Journal of the Society of Arts, Ciel et Terre, The Lady, The Tricyclist, The American Druggist*, and a magazine in Arabic, of which we are wholly unable to decipher either the title, place of publication, or contents.

The Post Office Telegraphs.—The gross amounts received and expended in respect of the telegraphic service from the date of the transfer of the telegraphs to the State to March 31, 1884, are stated to be as follow:—The gross amount received for telegrams in that period was £18,225,778, and the amount expended in the working of the department was £16,662,347, and £2,395,082 remained as a balance to meet interest on stock created on account of the telegraph service and the redemption of debt.

THE FACE OF THE SKY.

FROM MARCH 27 TO APRIL 10.

BY F.R.A.S.

THE Sun may, as usual, be examined for spots; but the epoch of maximum has now certainly passed, and no such splendid groups as rewarded the observer during the years 1883 and 1884 can now be expected. The zodiacal light is conspicuous at the sunset on clear evenings now. Map IV. of "The Stars in their Seasons" shows the face of the Night Sky. Mercury is an evening star, and may during the greater part of the time covered by these notes (and notably towards the end of it) be caught with the naked eye after sunset over the W.N.W. part of the horizon. At 2 a.m. on April 8th, he attains his greatest eastern elongation from the Sun (19° 15′). Venus is a morning star in a most indifferent position for observation. Mars is invisible. Jupiter is still the most conspicuous object in the sky, and may be well seen during the greater part of the night. He will depart but little from a point not far to the north and west of Regulus ("The Stars in their Seasons," Map IV.) during the next fortnight. During that time the phenomena of his Satellites will present much to interest the observer. To-morrow night (28th) Satellite I. will be occulted at 10h. 25m. On the 29th, the transit of Satellite I. will begin at 7h. 44m.; and that of its shadow at 8h. 35m. The Satellite will leave Jupiter's opposite limb at 10h. 4m.; its shadow at 10h. 55m. On the 30th Satellite I. reappears from eclipse at 8h. 0m. 54s. p.m., and the transit of Satellite II. begins 6 minutes after midnight. On the 31st, if the twilight be not too strong, perhaps Satellite III. may be seen to reappear from occultation at 7h. 13m. in the evening, only to plunge into the shadow of the planet in eclipse a minute and twenty-seven seconds later. It will reappear from eclipse at 10h. 41m. 50s. On April 1st, Satellite II. will be occulted at 7h. 11m., reappearing from eclipse at 11h. 53m. 11s. p.m. On the 4th Satellite I. will be occulted thirteen minutes after midnight. On the 5th the transit of Satellite I. begins at 9h. 32m., and that of its shadow at 10h. 31m. The egress of the satellite happens at 11h. 52m., and that of the shadow at 12h. 50m. p.m. On the 6th Satellite I. will be occulted at 6h. 40m. in the evening, to reappear from eclipse later at 9h. 55m. 35s. On the 7th Satellite III. will be occulted at 7h. 7m. p.m.; the shadow of Satellite I. will leave the face of the planet at 7h. 19m.; Satellite III. will reappear from occultation at 10h. 45m., to disappear afterwards in eclipse at 11h. 13m. 55s. On the 8th Satellite II. will be occulted at 9h. 34m. While, lastly, on the 10th, the egress of the shadow of Satellite II. happens at 8h. 40m., and Satellite IV. will be eclipsed at 10h. 13m. 51s. Saturn is now leaving us for the season, but may still be observed for a short time after dark in the west and west-north-west. He still forms a rude isosceles triangle with β and ζ Tauri ("The Stars in their Seasons," Map I.), and the very slight motion he has is in the direction of ζ. Uranus continues in an excellent position, and may be found roughly on a line joining η and β Virginis ("The Stars in their Seasons," Map. V.), towards which last-named star he is travelling. As we have previously said, he may be picked up to the west of η Virginis with the naked eye by any sharp-sighted observer who knows where to look for him. The moon is full at 4h. 40m. in the afternoon of the 30th, and enters her last quarter at 2h. 42m. 5s. p.m. on April 7th. There will be a partial eclipse of the moon on March 30th, but it will be practically over before she rises; inasmuch as the last contact with the true shadow of the earth happens at 6h. 9m. 7s., and she does not rise at Greenwich until 6h. 30m., when a part of her western limb will be but faintly obscured by the penumbra. One occultation only will be visible during the period our notes cover. It happens on the night of March 31, when the 6th mag. star B.A.C., 4,591, will disappear at the moon's bright limb at 9h. 20m., at an angle from her vertex of 18°, reappearing at her dark limb at 10h. 26m., at an angle of 240° from her vertex. At noon to-day the moon is in Leo, but descends into Sextans at 1 o'clock to-morrow morning; to re-enter Leo at noon to-morrow. At 11 a.m., on the 29th, she finally quits Leo for Virgo, across which great constellation it occupies her until 3 p.m. on March 1 to travel. At this hour she crosses into Libra, and in forty-eight hours' time (*i.e.*, at 3 p.m. on the 3rd) arrives on the western boundary of the narrow northern strip of Scorpio. She has crossed this by one o'clock in the morning of the 4th, and entered Ophiuchus. At midnight on March 5 she quits Ophiuchus for Sagittarius, out of which, at one p.m. on the 8th, she passes into Capricornus. At 8 a.m. on the 9th she crosses the boundary separating Capricornus and Aquarius, and is still in the last-named constellation when our notes terminate.

MESSRS. MARRIOTT & COOPER have taken premises in London at 65, Holborn Viaduct, opposite the Viaduct Station, where all the patterns of their celebrated Humber machines will shortly be on sale

THE INVENTIONS EXHIBITION.

THE arrangements for the lighting of the buildings and the grounds are being proceeded with. Some 18,000 incandescent lamps will take the place of the coloured oil-lamps for the illumination of the grounds and the roof of the large conservatory. Within the building there are to be 464 arc and 5,530 incandescent lamps, or more than double the number used last year. Twenty-one systems of electric lighting will be shown, equal to an illumination of 533,000 candles. The lighting committee is composed of Sir Frederick Bramwell, the Marquis of Hamilton, Sir Frederick Abel, Mr. W. H. Preece, Professor Dewar, Colonel Sir Francis Bolton, and Colonel Festing. The wiring will be executed by Messrs. Glover & Co. The steam-power which is to keep in motion the generators will again be provided by Messrs. Davey, Paxman, & Co.

It is announced that the Council of the Society of Arts are prepared to award the following Gold Medals in connection with the International Inventions Exhibition:—

JOHN STOCK PRIZE.—Under the John Stock Trust, one Gold Medal, for the best application of Photography to a Permanent Printing Process, Group XXVI., Class 140; Group XXIX., Class 159.

HOWARD PRIZES.—Under the Howard Trust, five Gold Medals, for the best exhibits (coming within the terms of the Trust*) in the following Classes:—One for the best exhibit in Group IV., "Prime Movers," Class 26. Steam-engines and Boilers. One for the best exhibit in Group IV., Class 27. Gas and Air Engines. One for the best exhibit in Group IV., Class 28. Means of Utilising Natural Forces. One for the best exhibit in Group XI., Classes 59 to 62. One for the best exhibit in Group XIII., "Electricity," Class 72. Distribution and Utilisation of Power.

FOTHERGILL PRIZE.—Under the Fothergill Trust, one Gold Medal for the most novel and best exhibit in Group XXVIII., "Philosophical Instruments and Apparatus," Classes 148 to 158.

ALFRED DAVIS PRIZE.—Under the Alfred Davis Trust, three Gold Medals to be awarded in Division II. of the Exhibition (Music), Groups XXXII. to XXXIV., Classes 166 to 180.

The Council propose to ask the Juries in each Class to recommend for their consideration either two or three exhibits which they might consider deserving a prize. It will not be necessary for any special application to be made in respect of these prizes.

A RETURN recently laid before the Legislative Assembly of New South Wales gives the cost of first-class American saloon-cars on the railways in that colony as £1,045 each, and second-class of the same pattern £805 each.

OUR excellent contemporary the *City Press* credits "Mr. J. Brown, Chairman of the London Tricycle Club," with the authorship of the article "How to Ride a Tricycle," in these columns. Of course, this is a slip (probably of the printer) for Mr. John Browning.

WE have received from Messrs. Marion & Co. a photograph of the Duchess of Albany and the infant Duke, which may fairly be regarded as a triumph of baby portraiture. The way in which the eyes are rendered is particularly successful. We are assured that the likenesses are excellent. The photographers are Messrs. Byrne & Co., of Hill-street, Richmond.

UNDER the heading "Scientific Ballast," an American paper says:—"Some years ago a most interesting find of fossils was made at the Portland, U.S., stone-quarries. They were of high scientific value, and it was decided to send them to Yale College for preservation and study. They were accordingly loaded upon a flat car at Middletown and sent on their way, a car-load of them. It was at that time that the fine stone bridge of the consolidated road was being built across the Farmington River at Windsor. After the arch of the bridge was set, the space was filled in on top with quantities of broken trap rock from the companies' quarries at Meriden. This broken stone at just this time was being drawn to Windsor by the cars for this purpose. The conductor of one train discovered the car load of fossils side-tracked at Berlin, and felt sure it was a lot of ballast for the Windsor Bridge which had been accidentally left behind. With commendable zeal he fastened to it at once, and drew it on to the bridge. There the rare fossils were dumped with the other stones, and there to-day they lie in the solid flooring of the massive bridge."—*Engineer.*

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* The Trust was left "for the purpose of presenting periodically a prize or medal to the author of a treatise on the properties of steam generally, or any of them particularly, as applied to motive-power, or it may be of air or permanent gases, or vapours, or other agents so applied, or to the inventor of some new and valuable process relating thereto."

XUM

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

All Remittances, Cheques, and Post Office Orders should be made payable to MESSRS. WYMAN & SONS.

The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

PHRENO-COSMISM AND REALISM.

[1646]—May I crave space to notice a sentence which seems to militate against the above theory, advocated by "C. N." and myself in these pages and elsewhere, in a late letter of "Hallyards"? In [1631] that able disputant writes, apparently inferring that we see things *per se*, as assumed by vulgar Realism:—"We have the testimony of billions and billions of men that facts [phenomena?] are presented to the senses in the same way." Arguing, hence, that the "phenomena" are envisaged in their *absolutely* real, and not in a *relative* or ideal form. But, surely, that conclusion by no means follows. For, if the organ* of perception be at once tool and workman, it moulds every "thing" according to its own, and not after any other pattern. And as all human brains are pretty much like as peas are alike—there being peas and peas, just as brains and brains—the products will be, so far, both alike as well. Certainly no two individuals see the same objects, or even the same light, yet we are practically justified in assuming that from structural similarity—not complete identity—of the organ of perception, percepts must appear organically analogous to billions of the same race. But change the structural nature or arrangement of the cerebral organism, and a complete "objective" transformation scene ensues. This result proves that the Ego itself is the *active* factor in perception and conception, sensation and thought—the *virtual* creator of all things or nothings, visible and invisible to its consciousness, which can thus only be "coinages of the brain" and *bodily*, not as in "Hamlet," *bodiless* creations.

ROBERT LEWINS, M.D.

DOES A UNIVERSE EXIST EXTERIOR TO OURSELVES?

[1647]—Your correspondent "Hallyards" objects to idealism on the ground that "certain facts are presented to the senses of all in the same way," and that it is very unlikely that "the whole race, differing on so many subjects of thought and belief, should yet be at one as to certain common phenomena, unless these phenomena are the manifestation of objective existence." There is some cogency in this argument as directed against pure idealism, which, indeed, cannot be seriously held, unless cloaked by that terminology which hides a multitude of metaphysical sins. Pushed to its logical limits, it would involve us in disbelief of the existence of our fellow-creatures, and even of the Ego itself. There is, without doubt, an interaction between the Ego and the surrounding universe, and it is not questioned that all our sensations are consequent upon stimuli. The hylo-idealist argues, not that stimuli are non-existent, but that a sensation can resemble nothing which is not a sensation, and therefore cannot possibly be like anything which may take place beyond the sphere of mind. *To us* there is no external world, because all that we know is felt or thought, and is therefore internal. C. N.

THE FALLACY OF MATERIALISM.

[1648]—It may be said of hylo-phenomonology and ontology, as it was said of phrenology, that "there is much which is true that is not new, and much that is new which is not true." It may confidently be affirmed that there is no educated thinker who does not understand the strong point in Berkeley's position, and who does not thoroughly recognise the relativity and limitations of human knowledge; and who, if he has had a taste for speculation, has not read G. H. Lewes's "Biography of Philosophy" through, and backwards and forwards. This work was published just as I, a lad, was probing the great question of thought. Some one has wisely said that if a man does not settle his philosophy ere he be forty it will be all over with him. All educated thinkers recognise the limitations of the conscious Ego—know, that our immediate knowledge is of the phantasma, the phenomena, of that Ego. Nevertheless, thinkers firmly believe in the existence of an external world, of which those phenomena are, for the most part, the telegrams; of these the scientist records the order and the succession, and from them deduces inferences. This *belief* in an external universe cannot consistently co-exist with the affirmation that the conscious Ego is the only universe; or, as it has been put by the hylozoists, that "man must be the centre, and man's God—from the *relativity* of all human *gnosis*—can only be the creature, the Narcissus-like reflection of himself." Believe in an external universe, however, and such a conclusion is no longer logically consistent, for that belief permits us to infer, that the microcosmic Ego may be, metaphorically, the image of the macrocosmic Ego. If, however, either Dr Lewins or "C. N." really believes that his (or her) conscious Ego is the only universe, it is clearly and utterly inconsistent for either to entertain the notion of external sensation in any shape, either as "matter and vis insita" or anything else. But each evidently does believe in an external existence beyond his own conscious Ego, and so hylozoism is brought down to the *terra firma*, the belief of ordinary mortals. C. N. says, in her letter, ante (1630), "It is quite true that we can only *infer* the existence of matter; but the inference is deducible from an assumption which lies at the basis of all reasoning whatsoever." Precisely so, and it is this *assumption* which changes the whole field of the Ego's mental vision, *voilà tout!* without having recourse to complex and bewildering nomenclature. W. CAVE THOMAS.

P.S.—In my letter (1613) please to read instead of "motion of matter," "notion of matter."

[With this letter the discussion must conclude.—ED.]

* Organ is in German *Werkzeug, i.e.*, work producer.

SALAMANDERS.

[1649]—I am afraid Mr. John B. Gansby will never succeed in getting mates for his two love-sick salamanders, because, though the salamander (that is, the spotted one—*Salamandra maculosa*) is very common in central Europe, almost all specimens caught are females, the males being exceedingly scarce. This is a fact well known to herpetologists, though it by no means proves that nature has deprived these gaudy daughters of hers from the bliss of wedded life. It is, indeed, more likely that some phase of the salamander's life, unknown to us, prevents us from finding, with but very few exceptions, the male, who may live hidden from the world, possibly from shyness, more likely from other reasons. As, however, spermatozoa have often been found in the cloaca of the female, one may reasonably assume that a union of the two sexes does take place, though this has never been observed.

I may add, in consolation to Mr. Gansby, who may desire to see and possess baby salamanders, that the females often bring forth young ones, in some cases even a second time, after having been kept in confinement for a long time. The same has been observed with females of some species of newts.

The cause of this, if it is not a parthenogenetic development of the eggs, may be that, once the female is fructified, the spermatozoa can develop the eggs after a long period.

Very little is as yet known of the life-history of this pretty and interesting batrachian, the young of which are born alive as tadpoles with the four legs fully developed, the eggs being hatched in the body of the female.

Let Mr. Gansby procure newly-caught specimens, and he may possibly have his wish fulfilled. I cannot tell him the difference between the two sexes, as I have never seen a male salamander, though I have caught and examined many females. J. G.

THE GROWTH OF PLANTS.

[1650]—An interesting example of the power of growing plants came under my notice a short while ago. The irresistible force of a growing tree by which a strong wall may be thrown down is well known, but the illustration I have alluded to shows quite a different aspect of this power.

In gathering wild snowdrops in a wood I observed that many of the leaves and flower-stalks had neatly pierced the dead leaves of last autumn which were thickly strewn over them. They neatly fitted the holes they had made in these withered leaves, and in many cases had raised them from the ground afterwards. The wonder appears to be that the growing stem or leaf did not push the light withered foliage aside instead of growing right through

it. The tree leaves are lying *loosely* on the ground, and, for the most part, are hard and dry. From their appearance they may have been in this state since their fall from the trees last autumn.

G. W. BULMAN.

WEAR OF SILVER COINS.

[1651]—I quote the following from an old number of KNOWLEDGE (Sept. 12, 1884):—"Mr. Miller some years ago made a number of precise experiments, from which it was ascertained that £100 worth of sovereigns lost £3. 9s. 8·4d. of their value in a hundred years. Similarly £100 worth of half-crowns lost £13. 11s. 8·8d., £100 worth of shillings £36. 14s. 3·1d., and £100 of sixpences lost £50. 18s. 9·8d. in value, or more than one-half in the hundred years. It will be noted here with regard to the silver coins that the less the value the greater the amount of wear. These silver coins are, of course, most used, and so, in the case of a sixpence, a century's wear reduces it to less than half its original value."

The reason mentioned in the above paragraph is not the complete explanation of the difference in wear. The surface of two sixpences being greater than that of one shilling, the wear of the two sixpences will also be greater than that of a shilling in the same ratio, if they are used only to the same extent. Taking this into account, we can obtain an estimate of the relative amount of use of the above-mentioned silver coins. The surface of any sum (say, £100) in the three cases when it is used in half-crowns, in shillings, and in sixpences will have the ratio 1 to $\left(\frac{5}{2}\right)^{\frac{1}{3}}$ to $(5)^{\frac{1}{3}}$, this is in the ratio of 1 to 1·3572 to 1·710.

Hence, if the loss on £100 worth of half-crowns for a given amount of use is £13. 11s. 8·8d. that on £100 worth of shillings would be about £18. 8s. 10d., and that on £100 worth of sixpences would be £23. 4s. 8d. Shillings therefore receive more use than half-crowns in the ratio of £36. 14s. 3·1d. to £18. 8s. 10d., approximately twice so much, and sixpences are more used than half-crowns in the ratio of £50. 18s. 9·8d. to £23. 4s. 8d., or less than $2\frac{1}{2}$, showing that the difference in the amount of use of shillings and of sixpences is by no means so great as indicated in the quotation.

It would be interesting to compare these estimates with any others that may have been framed of the relative use of these coins.

T. C. LEWIS.

THE NEW TIME.

[1652]—May I suggest a method by means of which, should the "new time" be adopted, striking clocks would not be any more perplexing than they are now? viz., by having *two* bells (a note with its 3rd or 5th, for instance), one to strike *tens* and the other *units*. By that means striking twenty-four would only require *six* "strokes"—two *tens* on one bell and four *units* on the other, and the greatest number of strokes would be *ten* instead of *twelve*, as it is now, viz., one ten and nine units for nineteen.

NIGEL DOBLE.

ULTRA-GAS.

[1653]—I desire to ask a little elucidation of the following from the *Saturday Review* on P. Muir's "Chemistry":—

"In the solid the molecular motion is limited, and is not attended with permanent change of position. In the liquid, motion is more free; the molecules change their respective positions, but do not escape from the range of each other's attraction. In the gas, and still more in that ultra-gaseous condition revealed to us by the splendid researches of Mr. Crookes, the motion of the molecules is so great that their mutual attractive force becomes insignificant."

Does this contradict, or not, the law of universal attraction as laid down by Newton? Or, is it to be understood, as a matter of course, that that law operates only within certain limits? As a matter of fact, has the sun any pull whatever on the nearest star, and *vice versâ*? "Insignificant" is an ambiguous word. Has Crookes shown that in ultra-gas there is *no* attraction *demonstrable?*

"Throughout these changes of state the substance retains its identity, because the molecules which determine its nature remain unaltered. But the molecules are themselves composed of still smaller, and, as far as we know, ultimate particles called atoms."

(He had previously called the molecules "ultimate particles." How can they be so if they have still lesser bodies within them?)

"The molecules are, in a sense, clusters of atoms, but atoms in motion, and not at rest. They are more fairly compared to solar systems than to piles of shot, and it is no more possible, from the size of the molecule, to calculate the size of the atoms inside, than it would be to calculate the size of a planet from the magnitude of its orbit.

Would it be plausible to hold that the universe is itself an ultra-gas, of which solar systems are molecules, and planets not, indeed, *ultimate* atoms, but of the same rank as the smallest atom we have hitherto discerned? This seems supported by the "insignificance" of the attraction of the particles in ultra-gas; comparable to that of stars *not* deflecting each other.

HALLYARDS.

P.S.—The review goes on:—"It is strange to remember that these atoms are themselves infinitely great as compared with the infinity of smallness below them. Each may be a solar system, or even a nebula of fixed stars to some immeasurably smaller speck. Great and small, as we call them, are equal in reference to infinity."

Surely this is "cutting it rather too fine." If it is true, how can they be *ultimate?* And if great and small are not positive terms, what basis is there for mathematics? Moreover, is it not probable that there is no single orb much bigger than Sirius? If so, there seems a limit to the size of molecules on one side; must there not be one on the other? Infinite size we cannot deny, though we cannot conceive it, but infinite *smallness* seems a contradiction in terms—if small, how infinite?

LETTERS RECEIVED AND SHORT ANSWERS.

NIGEL DOBLE. I am much obliged for your quotation from Bell, but it refers to the Newts, and not to the Land Salamander at all, to which Mr. Gansby's inquiry had reference.—J. GAVEY (Cardiff). Will you be good enough to read the italicised paragraph which appears (among other places) on p. 473 of the last volume of KNOWLEDGE?—E. W. P. I have no map of England on a large scale. In a table appended to an Atlas now before me, the longitude of Ellesmere is given as 2° 54′ (*i.e.* 11m. 36s.) west of Greenwich.—PRO BONO PUBLICO. The (so-called) "religious" journal from which you forward me a cutting is much too insignificant to do any hurt; and the mere calling attention to such terribly mischievous quackery can only do more harm than good. Equally circumstantial details of alleged "cures" at Hanley were given, and you saw what they came to. I must decline to insult the writer of the article on "Faith-Healings" by forwarding such rubbish to him; but, of course, you can yourself do so if you please. His address is Wm. Dunnett Spanton, Esq., F.R.C.S., Hanley.—F. W. H. The discussion on Mind and Matter is now closed.—H. O. C. Before attempting to instruct any one upon a given subject, it is just as well to take care that you possess some rudimentary knowledge of it yourself. "Science" does *not* "teach that there existed in pre-Adamite ages a race of animals with man-like skeleton," who were not "men in the sense," &c. What Science really does teach is that tool-making man lived in society contemporaneously with the mammoth, the reindeer, the lion, the cave bear, and the hippopotamus; nay, that he was even pre-glacial. Suppose that prior to dogmatising, you were to read Joly's "Man before Metals," Lyell's "Antiquity of Man," Sir John Lubbock's "Pre-historic Times," &c.; whence you would learn that your "race of animals" possessed the artistic faculty to an extent which enabled them to depict, from life, the reindeer upon his own horn and the mammoth upon one of his own tusks! Man, quite probably the equal of the existing Fuegian, lived where I am writing, when as yet the English Channel was not, and Norfolk and Germany were conterminous.—DR. LEWINS. I must adhere to my decision. Your reply to "Hallyards" is marked for insertion, though. Do not imagine that I am opposed to "the utmost latitude in speculation" because I do not print all you send me. I exclude it because, if I am to admit a contention in favour of atheism pure and simple, I cannot, in common fairness, exclude dogmatic theology, which our rules expressly exclude. Moreover, the pressure on our space, of matter of much wider and more popular interest, is enormous. I am at least as much alive to the evil wrought by superstition as you can possibly be. Your letter was unfortunately destroyed, with a score of others, when I decided on its rejection.—CHARLES FEW. Having uttered your protest, and delivered your conscience, I trust that you feel that you have now done your duty.—J. H. BROWNE. My education as a shipbuilder and rigger having been neglected, I cannot define all your technical (and some even obsolete) terms. The "spritsail yard," though, is a yard carrying the square spritsail beneath the bowsprit, and the "run of a ship" is the number of "knots" (1·15 mile) she makes in a day. "Munroe Doctrine" is (I fancy, but am not

sure) "America for the Americans"—*i.e.*, that no foreign states should intrude upon American territory. "Chauvinism" is the French for "Jingoism," "Palmerstonian," the "Civis Romanus sum," and other principles of Lord Palmerston.—Rev. Chas. Voysey. Four thousand miles is a long way to forward. You are quite right, and you will see from a reply above that I have put a stop to it. I do not myself see why *religion* should be excluded from a scientific paper; but theology is a very different thing.—Constant Reader. The loss of weight of a body transported from the poles to the equator from the centrifugal tendency alone is about $\frac{1}{289}$th part, *i.e.*, a body weighing 289 lb. at either pole would, from this cause only, weigh 288 lb. on the equator. There is, though, of course, a further loss of weight, having its origin in the fact that any point on the equator is more distant from the earth's centre of gravity than the pole is; the earth being not a sphere but an oblate spheroid.—If Cosmopolitan and C. W. Dymond care to communicate with the writer of letter 1619, p. 181, his address is, Hugh McMaster, Esq., Blainby, Port William, Wigtownshire.—J. G. Certainly not. The weight of a cubic foot of air with the barometer at 30 inches and the thermometer at 32° is 575 grains, and this is *saturated* with 2·37 grains of aqueous vapour.—J. V. Shaw. It is not genuine, and if you will take my advice you will have nothing to do with such an imposture.—W. R. K. Noting, in limine, that the mode of projection described is stated to be particularly applicable to a limited region of the heavens; in the case of a constellation on the equator, like Virgo, where the sensible convergence of the meridians is comparatively small, you might treat as much of the equator as you used as a continuous straight line.—Uncle John. I beg your pardon; I thought that you referred to some *sensible* movement among the fixed stars. Of course, they are one and all in motion; but so stupendous (nay, practically infinite) is their distance that such motion is only rendered perceptible by the most refined means of measurement. Our own sun, with his attendant system of planets and comets, is moving through space at a probable rate of some twenty-seven miles a second. Seventeen years ago, Sirius was receding from the earth at the rate of 29¼ miles per second, but in the year 1880 this motion of recession, which had been gradually diminishing, ceased; the star was for a short time seemingly stationary; and then the motion of reception was converted into one of approach. 1830 of "Groombridge's Catalogue" has an annual proper motion of some 7″, 61 Cygni one of 5″, and so on.—F. W. Rudler. Received with thanks. Could you furnish me with a short *précis* of the sight-testing papers and discussion?—The Worm. You have made your figure to fit a particular case. Take an angle of 45° and draw your parallels more obliquely (and, consequently, wider apart), and see where your A's, P's, &c., will fall then. Many a man has trisected an angle as nearly as his compasses, &c., would measure it, but on subjecting his process to the test of algebra, has found out that he has broken down.—Ignoramus. Your question would be an exceedingly pertinent one were the gnomon of a sun-dial *vertical*; but its edge is parallel to the axis of the earth.—Chaplain R. S. Stubbs (Portland, Or., U.S.). The testimonial is perfectly genuine. See final paragraph, in capital letters, which heads the Correspondence column.—Saml. Haigh. Assuredly, it has never "been asserted in Knowledge that the air we breathe is composed of living *insects*;" but undoubtedly innumerable millions of germs of life, animal and vegetable, do exist in the air which surrounds us.—A. Kinnear (the inventor of the self-lighting gas-burner and tap described in page 530 of our last volume) protests (at too great length for insertion) against the allegations contained in the letter (1558) by Mr. Pickard on page 38, as contrary to fact, and quite misleading.—C. A. Martineau. It reached me rather too late to be utilised.—A Puzzled Student. The orbit of the Moon round the Earth is approximately, and only approximately, an ellipse. It is not even a re-entering curve. As referred, however, to the *Sun*, the Moon's path is always concave. For consider that, as so referred, it must be an undulating line, alternately within and without the Earth's orbit. In a fortnight the earth travels rather more than twenty-two millions of miles in her orbit, or say 14°. Draw this angle on a piece of paper, and join the ends of the arc by a chord. At its middle point, this chord will fall 688,000 miles within the Earth's orbit, while the Moon in apogee is never, under any circumstances, 253,000 miles from the Earth's centre. Hence her path must always be concave to the sun. If you carefully read the work on "The Moon" by the Conductor of this journal, you will see how numerous are the perturbations she suffers, and will cease to wonder at the irregularity of her path. No articles dealing with your special difficulties have appeared in these columns.—Miss Mary Macleod. My goodness me! You take my breath away! Neither I nor any other astronomer can "explain" "from an astronomical point of view" why smoky fog came in at your open hall-door on March 15. As for filling columns with your terrific predictions, I wonder what the readers of Knowledge generally would say, especially when they learned how imminent the entire destruction of these islands is from earthquakes. Even the tremendously-high scientific authority of ex-Lord Mayor Ellis and Mr. Ruskin shall not tempt me to give up half a number, more or less, of this journal to treating its innocent subscribers as the fat boy sought to serve old Mrs. Wardle, and "make their flesh creep."—Miss Constance Naden. Many thanks both for the book and the paper on Beauty. The latter will appear.—Thomas Gaddes, David Houston, and others too numerous to mention. Declined with thanks. Please send stamped and directed envelopes for your MSS. if you wish them returned.—John Mansley. Surely you must see that the letter you send me is that of a fanatic, and an ill-informed one to boot. Can you reflect for a moment on the single instance of the unfortunate creature who was fetched out of his bed, "healed"!!! and taken back to *die*, without seeing what utter humbug the whole affair is? Would you, sitting as a juryman, dare to find a verdict of guilty against any one upon such evidence as is offered by the author of the stuff you forward?—C. W. P. Mr. Browning very kindly writes, "If C. W. P. is a tolerably strong rider, and will use the 'Sparkbrook' on fairly good roads, he will not find 56-in. gearing too high for him; but as the machine probably weighs 86 lb., I should prefer to have it geared to 52 in. for my own riding."—P. Q. suggests that the word "coercive" (or "coercitive") in magnetism might advantageously be replaced by "conservative," inasmuch as steel is unwilling to receive magnetism and unwilling to relinquish it.—Singer. Thanks, the attention of the writer of the paragraph shall be immediately called to your letter.—H. J. Copplestone. Undoubtedly an electrical phenomenon. In Canada and other places where the air is cold and extremely dry, sparks may be drawn from almost any part of the body that has been exposed to friction. Combing or brushing the hair will always elicit them.—Excelsior. Forwarded as you specially request. You can hardly get a reply for five or six weeks though.

The Royal Society of New South Wales.—[I accede to a request to make the following public, inasmuch as it simply amounts to an offer of rewards for work actually accomplished, and contains no proposition to foster the quack and the advertising man of "science" (?) by "endowing" him first and leaving him either to find something out—or leave it alone—afterwards.—Ed.] "*Original Researches.*—The Royal Society of New South Wales offers its medal and a money prize for the best communication (provided it be of sufficient merit) containing the results of original research or observation upon each of the following subjects:—Series IV. (to be sent in not later than May 1, 1885): No. 13, Anatomy and life history of the echidna and platypus—the Society's medal and £25; No. 14, Anatomy and life history of mollusca peculiar to Australia—the Society's medal and £25; No. 15, The chemical composition of the products from the so-called kerosene shale of New South Wales—the Society's medal and £25. Series V. (to be sent in not later than May 1, 1886): No. 16, On the chemistry of the Australian gums and resins—the Society's medal and £25; No. 17, On the tin deposits of New South Wales—the Society's medal and £25; No. 18, On the iron ore deposits of New South Wales—the Society's medal and £25; No. 19, List of the marine fauna of Port Jackson, with descriptive notes as to habits, distribution, &c.—the Society's medal and £25. Series VI. (to be sent in not later than May 1, 1887): No. 20, On the silver ore deposits of New South Wales—the Society's medal and £25; No. 21, Origin and mode of occurrence of gold-bearing veins and of the associated minerals—the Society's medal and £25; No. 22, Influence of the Australian climate in producing modifications of diseases—the Society's medal and £25; No. 23, On the infusoria peculiar to Australia—the Society's medal and £25. The competition is in no way confined to members of the Society, nor to residents in Australia, but is open to all without any restriction whatever, excepting that a prize will not be awarded to a member of the Council for the time being; neither will an award be made for a mere compilation, however meritorious in its way. The communication, to be successful, must be either wholly or in part the result of original observation or research on the part of the contributor. The Society is fully sensible that the money value of the prize will not repay an investigator for the expenditure of his time and labour, but it is hoped that the honour will be regarded as a sufficient inducement and reward. The successful papers will be published in the Society's annual volume. Fifty reprint copies will be furnished to the author free of expense. Competitors are requested to write upon foolscap paper, on one side only. A motto must be used instead of the writer's name, and each paper must be accompanied by a sealed envelope bearing the motto outside, and containing the writer's name and address inside. All communications to be addressed to the honorary secretaries, A. Liversidge and A. Leibius, the Society's house, 37, Elizabeth-street, Sydney."

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals.*

BIRD-CAGE.

[Patent, No. 2,577. 1884.]—Mr. F. Ostler, of Yeovil, has patented an improved cage in which to exhibit canaries and other birds at cage-bird shows, which will, doubtless, be welcomed by those who are in the habit of exhibiting birds at these shows, which are now held in all parts of the kingdom. The invention does away with the use of wrappers, and affords protection to the birds from draught and cold when travelling to and from an exhibition. The device is as follows:—A metal slide, hinged in the middle so as to fold up, and with perforated spaces for admitting air to the birds, is fitted to grooves in the edges or corners of the cage, so as to cover the wire front, and afford the necessary protection to the birds.

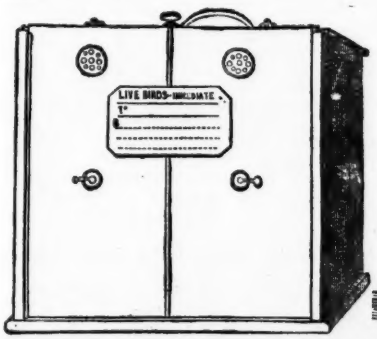


Fig. 1.

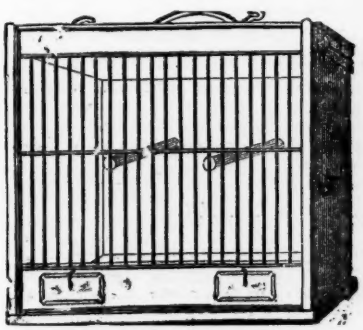
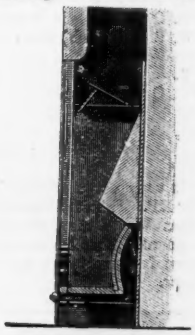


Fig. 2.

The cage is made with a double top, with a space between its two parts, an aperture being cut in the side of the cage leading into the space. On the arrival of the cage at an exhibition, the metal slide is removed from the front of it, folded up, and placed in this space, and is thus ready at hand for placing down the front again as soon as the exhibition is over and the birds are ready to be returned to their owner. The invention may be better understood by reference to the accompanying illustrations. Fig. 1 shows the metal slide in its position in front of the cage. Fig. 2 shows the metal slide folded and placed in the space at the top of the cage. The cage is already spoken highly of, more particularly on account of the time saved by its adoption.

REGISTER STOVE.

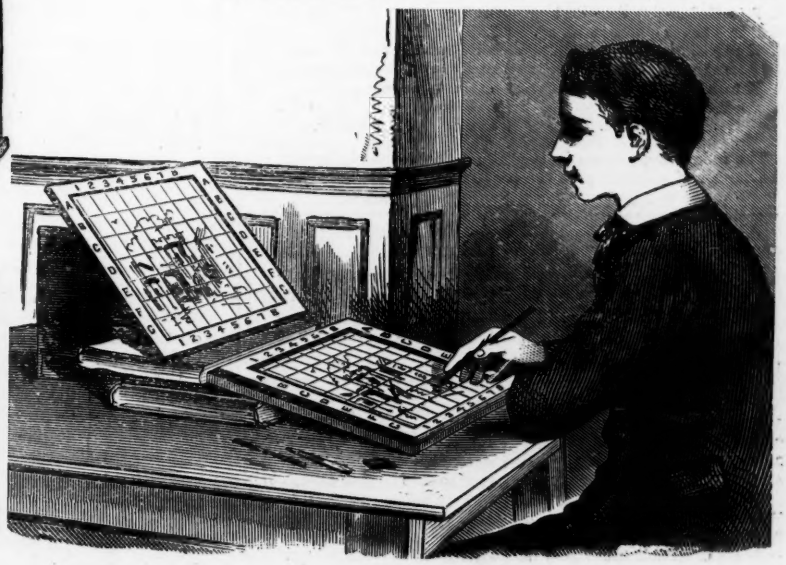
[Patent, No. 7,125. 1884.]—Mr. Frederick Brown, of the firm of Brown & Green (Limited), Luton, Bedfordshire, has patented a new form of stove, in which a large firebrick overhangs the back of the fire. It has also a solid brick or iron bottom, and a grated back. A little below the bottom is another plate, the space between the two forming a chamber in which air entering from the front



becomes heated. This chamber communicates with the grating at the back, whence a constant current of hot air is discharged through the back grating into, upon, and over the top of the fire, the result being a more perfect combustion, with the production of little or no smoke, and a proportionately increased heating power, the fire, too, presenting a cheerful aspect. The accompanying illustrations, section and perspective view respectively, will help to explain the patent.

THE RECTOLINE.

THIS is a useful and simple piece of apparatus, introduced by Messrs. Wolff & Son, of Great Queen-street, London. Its



The Rectoline.

object is to assist the beginner in his effort to obtain correct proportions in copying drawings, prints, &c. The work to be copied is pinned to the back of a separate wooden frame—another similar frame is hinged on to a drawing-board. A sheet of paper is cut to the size of the board and pinned on, and the attached frame is allowed to fall on to it. The copy and blank paper are alike divided into squares by means of threads stretched across the frames. The outline of the drawing can then be easily copied by following the detail contained in each square, letters and numbers being stamped or printed on the frames to indicate the corresponding spaces. The outline being completed, the frame is raised and the drawing completed.

XUM

Our Chess Column.

By Mephisto.

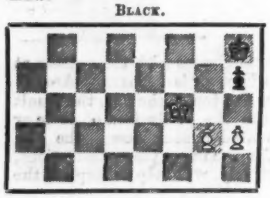
Solution of Problem No. 150, p. 228.

1. P to Kt3	P × P, or	1.	B × P
2. Q to B2!	P × Q	2. P × P (ch)	B × P
3. B to R2 (ch) mate		3. Q to Q7 (ch)	mate
Or if		If 1.	P × Kt
2.	Any other	2. Q × P (ch)	K to K4
3. Q mates accordingly		3. Q to K4 (ch)	mate.

USEFUL END GAMES.

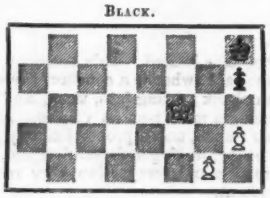
It very often occurs that White is left with RP and KtP against the RP. In actual practice the usual result is a draw, but in many cases White may win if he obtains the opposition at the right moment. Two P's against one in the middle of the board, although more favourably placed, nevertheless often can do no more than draw.

Black.



White can only draw.

Black.



White wins.

There are numerous positions in which Black gets into a stalemate position if White advances his Pawns too rashly as in the above positions. The termination is as follows :—

1. P to Kt6 or (*a*)	P to R3 !
2. P to Kt7 (ch)	K to Kt sq.
3. K to Kt6 drawn.	
(*a*)	
1. K to B7	P to R3
2. P × P or P to Kt6	
Drawn game.	

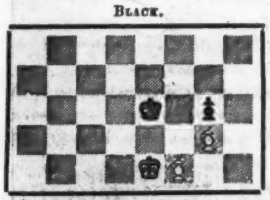
1. K to B7	P to R3
2. K to Kt6 and wins.	

Supposing the P's are placed on Kt5 and R4, the result would be the same, e.g.,

1. K to B7	P to R3
2. P to Kt6 ! and wins.	

The following positions in the middle of the board likewise show the danger of advancing Pawns too rapidly, e.g.,

Black.

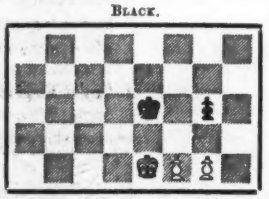


White can only draw.

1. K to Q4	K to Q3 ! (*a*)
2. K to Q3	K to Q2
3. K to K3	K to K2
4. K to K4	K to K3

(*a*) If Black plays 1. K to B4, White gains the opposition by 2. K to K3, K to K3. 3. K to K4 and wins. Black must play so as to oppose the White K always when he reaches the 4th line.

Black.



White wins.

In this position, White having a move at disposal, gains the opposition, e.g.,

1. P to Kt5	K to B2 (*b*)
2. K to Q5	K to K2
3. K to K5	K to B2
4. K to Q6	K to Kt sq.
5. K to K6	K to Kt2
6. K to K7	K to R sq.
2. K to B6	K to R2
3. K to B7 and wins.	

The principle on which opposition is gained may easily be learned with a little practice. It will be seen that in the first position the Black K remains on the second line as long as White stays on the third, Black thereby being enabled to oppose the White K either on K3 or Q3 immediately White plays K to K4 or Q4.

(*b*) In the second position Black might also play as follows :—

1. P to Kt5	K to Q3
2. P to B5	K to K2
3. P to B6 (ch)	

If P × P, White wins by reaching the square on R7 with his K.

If White plays P × P, Black would draw by K to B sq.

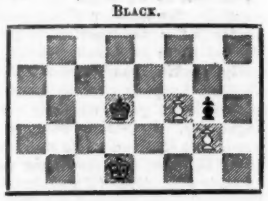
	K to K3
4. K to Q4	K to Q3

bringing about the following position :—

Now White gains the opposition by giving up the P, e.g.,

5. P to B7	K to K2
6. K to K5	K × P
7. K to Q6	K to B sq.
8. K to K6	K to Kt2
9. K to K7	K to Kt sq.
10. K to B6	K to R2
11. K to B7	K to R sq.
12. K × P	K to Kt sq.
13. K to R6	K to R sq.
14. P to Kt6	K to Kt sq.
15. P to Kt7	K to B2

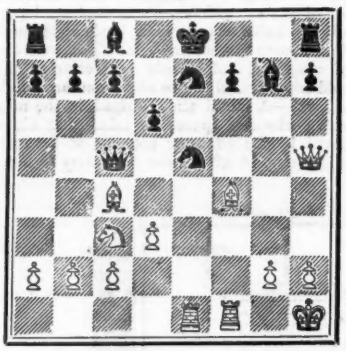
Black.



16. K to R7, and wins.

ENDING FROM ACTUAL PLAY.

Black.



White.

White won with

B × Kt	B × B
R × P	K to Q sq.
R × Kt !	

This move, in conjunction with the following play, forms a very pretty combination.

	K × R
Q to B7 (ch)	K to Q sq.
Kt to Q5	R to K sq.
B to Kt5 !	Resigns

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Wilfred John Taylor.—In the game on p. 228, K to R3 is obviously a misprint for K to R2.

Edw. Carter.—We fully appreciate your good opinion.

Correct solutions of Problem No. 150 received from H. A. N., E. Louden, Ravenshoe, Uncle John.

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NOTICES.

Part XL. (Feb., 1885), now ready, price 1s.; post-free, 1s. 3d.

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